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SUBMARINE CABLES.

THE construction and laying of a submarine cable is not at the present day looked upon as a feat of any considerable magnitude. Many, no doubt, will recollect the days when the laying of a cable was made the occasion of great festivities at the localities connected by the submarine link, but now a matter of the kind is one of such very ordinary occurrence that it is not considered worthy of greater notice than that afforded by a short paragraph in a spare corner of the daily paper. The changes which have taken place in cable manufacture since the first successful cable was laid (but thirty years ago) have not been very marked, though they have added very considerably to the insuring of success. The present type of armoured cable, the general idea of which was, we believe, first suggested by Mr. Newall, has been adhered to in the main since its first introduction, and it does not seem likely to be superseded. First we have the insulated core, then the hemp padding, and afterwards the iron sheathing. In the original cables this practically completed the whole arrangement, and even at the present day it is in some cases adhered to, though we think it is a mistake to do so. The first decided improvement introduced was that adopted in the 1865 Atlantic cable; it consisted in sheathing each of the protecting iron wires with a coating of yarn. This had the advantage of preventing the ends of a broken wire from projecting and catching in the paying-out machinery during the laying operation, an accident which would be almost certain to have a serious termination. This device has been superseded by the simpler and more effectual plan of sheathing with bare wires, as in the older type of cable, and then covering the whole with yarn and Clark and Bright's silicious compound. A still more recent improvement consists in the serving of the armoured cable with a double layer of tarred tape, well covered with the silicious compound. This gives the whole cable an excellent finished surface, whilst the tape most effectually prevents broken ends of the iron sheathing from protruding, much more so than when the yarn serving was employed. There can be no question but that this last improvement is a very decided one. The use of wet yarn for the serving immediately over the insulated core was first carried out in the Atlantic cable of 1866, and the practice has been continued ever since, so that any slight fault which may exist in the insulated core is certain to be detected during the course of manufacture. In the construction of the insulated core itself there does not appear to be very much room for improvement; a conductivity of at least 96 per cent. of pure copper for the conductor is obtained with perfect ease and no lower standard would be admitted. As regards insulation there is no room for improvement with respect to the maximum value it should have; indeed, as we have more than once pointed out, the statement that a particular material must be of exceptional value because its specific insulation is extremely high, is of little or no account except to delude the public. The clause that specifies that the insulation resistance of a cable shall not be below a certain value is really a very slight guarantee that the cable shall be good, and if manufacturers were to adhere merely to the letter of a specification they could easily insist on what is practically a faulty article being accepted. Good electrification with high battery power, which is one of the best proofs of the soundness of a cable, is seldom if ever specified for; there seems, indeed, to be a dislike to altering established precedents although they may be quite out of date. With any respectable manufacturer who has a name to lose, a mere outline specification is practically as binding as one full of details, but if the latter are given, they ought, as far as possible, to be complete.

AUTOMATIC PRINTING OF TELEPHOTIC DISPATCHES OR THOSE TRANSMITTED BY LIGHT.

By M. MARTIN DE BRETTES.

EVERY printing apparatus, in order to act, requires the mechanical work of a force which is manifested to the purpose, that is to say, when and how the sender of the dispatches wishes.

This small force is required for the magnetisation of an electro-magnet, and the mechanical work serves for the attraction of the keeper, the movement of which determines the action of the apparatus.

In order to solve the problem of printing telephotic dispatches at the receiving station, the light projected must have the power of producing there, during its continuance, which depends on the will of the sender, the magnetisation of an electro-magnet, forming part of a local battery, or an augmentation sufficient for it to overcome the opposing spring of its keeper.

The illuminated part of the circuit of the battery must consequently be composed of a body endowed with the property of becoming suddenly conductive under the influence of light, and of ceasing to be so when the light is withdrawn. There exists, as is known, a body which possesses this property in a very high degree, namely, selenium.

The electric light produced at the receiving station in a Mangin's projector is sent there as a bundle of parallel rays, and received upon a converging lens, at the focus of which is fixed the selenium element forming part of the circuit of the local battery, which contains the coil of the electro-magnet moving the receiver.

The impression of the jets of light in black marks, long and short, according to the Morse alphabet, is made with the Morse apparatus. The jets of light are transmitted by the movement of a simple lever which displaces a screen. The printing of the dispatches in ordinary type is effected by means of a Breguet frame-receiver, the needle of which is replaced by a type wheel, and to which is added a printing mechanism, which acts by means of a special battery, and only when it is wished to print some given letter.

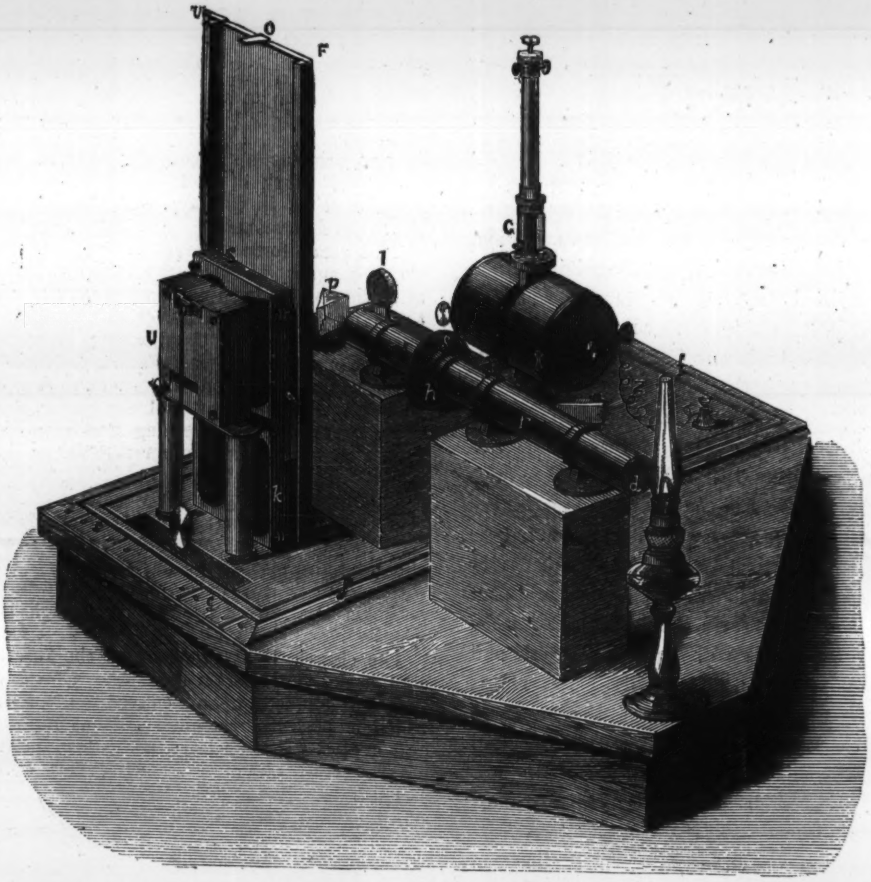
The distance between two stations depends on the transparency of the air, on the latitude and, all other things being equal, on the quantity of light received per unit of surface when the luminous rays are parallel. The law of the decrease of the intensity of light in this case is not known; but it depends solely on atmospheric absorption, for in a vacuum the intensity would remain constant. We cannot determine *a priori* the distance of the two stations for a given electrical focus; recourse must be had to experience.

The fine experiment of M. Fizeau for determining the speed of light shows that the distance of two stations might be considerable with the modern powerful electric lights which exceed 2,000 carcels.

We know, in fact, that in these experiments the light of a lamp gave after a course of 17 kilometres a brilliant focus of very appreciable intensity.—*Comptes Rendus.*

REGISTERING APPARATUS FOR EARTH CURRENTS.

For the purpose of studying the earth-currents on telegraph lines, Wauschaff, of Berlin, has made for the earth-current committee of the German electro-technical society a piece of apparatus, shown below, which, when connected in circuit with a telegraph line, will indicate the varying strength of the current in the line, registering the results on a diagram. The earth-currents are generally very weak, and can only be shown by the most delicate galvanometers, so that no registering apparatus requiring a great amount of force could be employed. This necessitated the use of photography. That the observations might be independent of the hour of the day, an artificial source of light was used. The most sensitive dry plates were called into requisition, and, to keep out all extraneous light, the whole apparatus—the description and illustration of which are from *Zeitschrift für Instrumenten Kunde*—is covered with a wooden box, not shown in the illustration. This cover turns on the hinges at *c*, and, when closed, rests in the grooves, *f*. The tubes *r* and *r'* are furnished with two cloth-lined metal collars, which can be pressed up against the box where the tubes pass through it. The outer end of *r* is closed with a plate in which there are three round holes side by side in a horizontal line. Before this plate is the diaphragm, *d*, which can be turned on a vertical axis, and through which there is one hole. With this diaphragm the central opening in the end of *r* may be alone left open. In front is placed a kerosene lamp. From the flame of this lamp a fine pencil of rays passes through the hole in *d*, along the tubes *r* and *r'*, and is reflected by a total reflecting-prism, *p*, which throws it on the mirror, G, of the galvanometer, which is connected in circuit with the line by the wires, *z*. From the mirror, G, the light is reflected back through the lens, *l*, which brings the rays to a focus on the photographic plate. This plate is put in a holder, *k*, in the slide, S, before the beginning of the observation. There are spring clamps on S, so that when the cover is drawn from in front of the plate the holder will remain in S. In order that it may be possible to expose the plate after the box-cover is put down, there is a slit covered with rubber cloth in the box, through which the fingers may reach the top of the plate-holder and pull out the sliding front. The slide, S, travels on guides, F, and is furnished on one side with two rollers, and on the other with one, so that the movement may be as straight as the guide against which the two rollers press. In the front side of F there is a horizontal slit at the height of the focus of the rays. The backside of S carries a rack which fits a pinion on the driving axis of the clock, U. The downward movement of S is therefore regulated by this clock, of which it forms the driving-weight. The downward velocity is about 80 mm. per hour. This is sufficient to allow of changes from minute to minute being easily distinguished. For the purpose of allowing different rates of speed, it is proposed to put another rack on the back of S, which, by a sliding motion, may be made to catch on a second pinion of different size. For lesser changes the pendulum may be varied in length.



The wires leading to the galvanometer are connected with a commutator. When the needle is in its position of rest, a straight line will be marked on the plate by an upward movement of the slide. From this line the deflections caused when the earth-currents pass are measured. Time-signals may be made by turning back the diaphragm, *d*, when marks will be made on each side of the neutral line. From time to time currents of known strength may be sent through the apparatus, and will produce dots.

Electrical Accumulator.—By H. Müller.—A quadrangular trough, lined at the bottom with slag-wool or asbestos, is divided into two compartments by a horizonal diaphragm of parchment paper, unglazed porcelain, &c., bent in a zigzag manner. These compartments are filled with a mixture of coke and litharge, or red lead. Two plates of coke or lead, fixed on the sides of the trough, serve as electrodes.—*Wiedemann's Beiblätter.*

INDUCED CURRENTS IN A MAGNETIC FIELD.*

By LIEUT. J. B. MURDOCK, U. S. Navy.

THE great development of modern electricity can be directly traced to the discovery by Faraday, in 1831, of the principle of electro-magnetic induction. From his discovery that the movement of a conductor near a fixed magnet, or a closed circuit through which a current was flowing, caused a current to flow though the conductor moved, has arisen the dynamo machine with all its applications. The principles, therefore, underlying the observed facts are of great commercial importance. Since the days of Faraday they have been carefully studied, and from the results of these investigations many useful, practical relations can be drawn.

In order to obtain the mathematical relations in a practical form several definitions and conventions have to be established, and it will be advisable to consider some of these. The region, whether near a magnet or not, throughout which magnetic effects are produced is called a *magnetic field*. Thus every current causes a magnetic field, as is evident from the deflection of a magnet near it. A unit magnetic pole is a magnet pole of such a strength that when placed one centimetre from an equal and similar pole, it would repel it with the force of one dyne. A magnetic field is of unit intensity when a unit pole placed in it is acted upon with a force of one degree. By comparing the last two definitions, unit pole evidently produces unit field at unit distance. The same intensity would evidently exist at a greater distance from a more powerful pole, as at two centimetres from a pole of strength four, or as three centimeters from a pole of strength nine. When a numerical value is given to the strength of a field, the evident meaning is that a unit pole would be acted on by a force of that number of dynes. As an intermediate step in comparing the magnetic effects of magnet poles and voltaic currents, the conception of a *magnetic shell* is useful. This is supposed to be a thin disc of any shape, having its opposite side of opposite magnetic polarity.

In order to investigate the action in a magnetic field, it is sufficient in any case to know the direction and intensity of the force acting on unit pole at all points in the field, and any scheme delineating graphically, or otherwise, the force and direction of its application at all points, will be a true representation of the field. One of the earliest and best methods is that due to Faraday, of sprinkling iron filings on a sheet of paper over a magnet. The experiment is common, and the curved lines in which the filings arrange themselves between the poles are well known. Made in this way, the resulting curves are not strictly accurate, as they are all in one plane, while the field extends in all directions around the magnet, but they illustrate clearly how a field may be considered to be mapped out, and are of assistance in comprehending other suppositions. These curves evidently show the direction of the magnetic forces, and are therefore called lines of magnetic induction, or more commonly *lines of force*. The force on a unit pole is the greater the nearer it is to the magnet, and in this experiment the lines of force are more numerous near the magnets, leading immediately to the conception that the closeness of the lines to each other may be a measure of the force, and consequently of the intensity of the field at any point. Maxwell has shown that if in any part of the field the number of lines of force passing through unit area is proportional to the magnetic force at that point, the number passing through unit area in any other part will correctly represent the magnetic force there. This conception leads to a new definition of intensity of field, which is that the intensity of field at any point is the number of lines of force passing through a square centimetre perpendicular to the lines at that point. In a unit field, therefore, one line of force passes through each square centimetre of a plane perpendicular to the lines of force. If the lines of force are parallel as are those of the earth's magnetism in any small area, the field is said to be uniform.

A line of force being the direction in which the magnetic forces act, is shown at any point by the direction taken by a suspended magnet. It is impossible to imagine two lines of force crossing at a point in space, as two conflicting forces at that point would unite to form a resultant force, and the direction of this would be the line of force passing through the points. Every magnet consists of two poles, which in any field are acted upon by forces in different directions, but being inseparable, the resultant motion of the magnet is due to the difference of the forces. It is easy to see, however, from any observed motion, how a single north pole would move if it were perfectly free, and this gives the positive direction of the lines of force as that in which a free north pole would move. This, in the field, is of course from north to south polarity. It is of the utmost importance to bear this convention clearly in mind. As the lines of force indicate the direction of the force, there can be no force exerted in a direction at right angles to them. Surfaces everywhere normal to the lines of force are called equipotential surfaces, and the relation between the lines and the surfaces enables one to be derived from the other.

It may be well to investigate one or two special cases illustrating the conventions already adopted. In a uniform field, as the lines of force are parallel, the equipotential surfaces are planes. The direction of the lines is in the earth's field indicated by the dipping needle, and the positive direction is downward in the northern hemisphere. In the case of a free pole the lines of force are radial from the point and the equipotential surfaces are spheres. If the pole is of unit strength there must be one line of force through every square centimetre of a sphere of unit radius, making 4π lines of force in all. The number for a pole of strength, m, would similarly be $4\pi m$, and the intensity of the field at any point would be shown by the number of these lines passing through unit area of an equipotential surface containing the point. The positive direction of the lines of force is from the pole if it is north, towards it if it is south.

If a magnet pole be moved in a magnetic field work must be done. This work may consist of work done in moving the pole against a repelling force, or in preventing its movement by an attractive force. As these are directly different the former is called positive and the latter negative work. If, now, after positive work has been done on the pole, as for instance in moving a north pole towards another, it be left to itself it will tend to move away. It has evidently acquired potential energy, and as this is due to the work previously done on it, this work becomes a measure of the potential energy gained. The term *potential* is used to express this relation, and is measured at any point by the potential energy possessed by a unit pole at that point. The definition commonly given for magnetic potential is that it is measured by the work required to move a unit pole from an infinite distance to that point. The work measured in ergs is numerically equal to the potential measured in units of potential. If a pole of strength two were brought up from infinity, twice the work would have to be done on it, but the potential at the point would be the same as at first. The potential is therefore equal to

$$\frac{\text{Work done in moving pole.}}{\text{Strength of pole.}}$$

Work and potential are evidently different, but are frequently confused. In every magnetic field there is a distribution of magnetic potential, the potential at a point near the magnet pole being greater than at a point more remote, and greater as the strength of the pole producing the field is greater. The potential at a point due to a pole of strength m, can be proved to be $\frac{m}{r}$, r being the distance from m. All points equally distant would therefore be at the same potential, or the equipotential surfaces would in this case be spheres as already stated.

As potential is measured by work done, there can be no work done in a surface normal to the direction of the forces in the field, and consequently the equipotential surfaces would in all cases be perpendicular to the lines of force, as in any other direction some component of the force would act and work would be done.

Gauss showed that the potential due to a magnetic shell at any point would be ωi where ω is the solid angle subtended at the point by the shell, and i is the strength of the shell. At all points on an equipotential surface the value of the solid angle must be the same. The measurement of the angle becomes extremely difficult at points situated obliquely to the axis normal to the shell at its centre, but it can be easily seen that as the point becomes oblique it must come nearer to the shell. In the plane of the shell itself the solid angle, and consequently the potential, are everywhere zero. The general shape of the surfaces is therefore that of deep bowls, concave towards the shell, and most remote from it on its axis. The lines of force start normal to the shell on its north side, and curve round, cutting successive equipotential surfaces at right angles to the south face, into which they fall perpendicularly.

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* From Van Nostrand's *Engineering Magazine*.

If a pole of strength, m, be brought up to a point near a shell, the amount of work done will, as already stated, be m times that done in bringing a unit pole up to the same point, or m times the potential due to the shell at that point. The expression $\pm m\omega i$ is therefore a measure of the work done, being positive if it required work to be done to move the pole, negative if work had to be done to prevent its movement still farther. As we have seen, the number of lines of force of a pole of strength m is $4\pi m$. This number radiate through a solid angle 4π, which is the solid angle at the centre of a sphere. Through any solid angle ω, the number of lines would therefore be $m\omega$, and representing this number, cutting the shell by N_1, the work done is expressed by $\text{N}_1 i$. Similarly, if the pole had been brought to a point at which the potential due to the shell was $\omega_1 i$, the work done would have been $m\omega_1 i$, or $\text{N}_2 i$. Potential being measured by work done, any change of potential can be obtained only from work. If, therefore, the pole be moved from one point to the other, the work done on unit pole is measured by the differences of the potentials, or,

$$v_1 - v_2 = \pm\, i\,(\omega - \omega_1).$$

If the pole, m, is moved, the work done is

$$m\,(v_1 - v_2) = \pm\, i\,(\text{N}_1 - \text{N}_2).$$

Any relation traced for a magnet shell is capable of application to a closed voltaic circuit. The lines of force of a current encircle it concentrically, as is shown by the tendency of a magnet pole to move at right angles to the direction of the wire. If a wire carrying a current be bent into a closed curve, the lines of force in passing round the wire would combine their effects on a magnet pole placed near, so that the resultant line of force would be normal to the plane of the circuit; or, in other words, the magnetic effect of a closed circuit is the same as that of a magnetic shell. By adopting a particular ratio of units the magnetic effect of any voltaic circuit may be made equal to that of a magnetic shell of a given strength whose edges coincide in position with the circuit. The electro-magnetic unit of current fulfils this relation, being that current, unit length of which acts with a force of one dyne on unit pole at unit distance. This unit of current, therefore, causes unit field at unit distance, as by definition does also a shell of unit strength. By measuring our current, therefore, in these units, the relations traced for the field due to a shell can be applied to that produced by a voltaic circuit.

The potential due to a voltaic circuit through which a current of strength, C, is flowing is $-\text{C}\omega$, the negative sign being due to the fact that a positive current causes a negative potential. The positive direction of a current is that in which the hands of a watch move, but if the north pole of a magnet be brought near a circuit in which the current is flowing in this direction, it will be *attracted*, or negative work is done in moving a free north pole up to such a circuit. The potential is therefore negative, and, as in the same way experiments show that a current in the negative direction causes a positive potential, the potential due to a voltaic circuit must always have the opposite sign from that of the current. The equipotential surfaces and lines of force are similar in character and number to those of the equivalent magnet shell. The direction of the lines of force is important, and can easily be determined by the simple experiments referred to. A positive current in a circle attracts a north pole, and the positive direction is therefore towards that face on which the current appears to flow in the positive direction. Viewed from the other side of the circuit, the current would appear to be negative, and on that side a north pole would be repelled. These relations are summed up by saying that the directions of the current and the lines of force are related in the right-handed cyclical order. A useful comparison is that commonly given by the use of a corkscrew. If the wrist be rotated to the right, the point of the screw advances. Letting the rotation of the wrist correspond to the movement of the current, the motion of the point will be that in which a north pole moves, or the positive direction of the lines of force.

As the relations proved for a magnetic shell hold in the case of a closed voltaic circuit, the work done in moving a pole, m, near a closed circuit in which a current of strength, C, was moving is $-\text{C}\,(\text{N}_1 - \text{N}_2)$, N_1 and N_2 representing as before the number of lines of force of the pole which are enclosed by the circuit. If the pole were fixed and the circuit moved the same work would have to be done, as the same forces of attraction and repulsion would have to be overcome through the same distance. This expression becomes, therefore, the formula for the work done in moving a closed voltaic circuit in a magnetic field. If N_1 is larger than N_2 the work done is negative, or the circuit tends to place itself in a position in which it encloses the maximum number of lines of force. If the direction of the lines of force of the field is opposite to those of the circuit, the latter will, if free to move, first rotate so as to bring its own lines of force to correspond in direction to those of the field, and will then move in such a direction as to enclose the maximum number possible. It is seen in this connection that a maximum of negative lines is practically the same as a minimum of positive. The number of lines enclosed by the circuit depends on the inclination of its plane to the direction of the lines, varying in the ratio of the sine of the angle the lines make with the plane of the circuit. If this angle is called θ, the circuit tends to turn into a position in which $\theta = 90°$, and the work it would do in turning, or the potential energy it possessed before movement, is measured by the expression $\text{C}\,(\text{N}_2 - \text{N}_2 \sin.\ \theta)$. This principle is evidently of importance in its relation to electro-motors, but we must continue on another line of investigation.

If a closed circuit be placed in a magnetic field it will exhibit no tendency to move if no current be passed through it. If a current pass the wrong way, the circuit will, as we have seen, move to make the number of lines of force enclosed a maximum. In doing so it performs work, and this work must be derivable from the energy of the current. Part of this energy is dissipated as heat, and part expended in moving the coil. We have, therefore, t, being the time occupied in the movement,

$$\text{C E}\,t = \text{C}^2\,\text{R}\,t + \text{C}\,(\text{N}_1 - \text{N}_2) \quad . \quad . \quad . \quad (1)$$

or

$$\text{CR} = \text{E} - \frac{(\text{N}_1 - \text{N}_2)}{t}.$$

But CR is the E.M.F. remaining in the circuit, and is less than the original E.M.F. by the quantity

$$\frac{\text{N}_1 - \text{N}_2}{t}$$

which must also be of the nature of an E.M.F., but acting in opposition to that already existing. This expression is, therefore, the measure of E.M.F., induced in the circuit by its motion. $(\text{N}_1 - \text{N}_2)$ is the change in the number of lines enclosed by the circuit at the beginning and end of the time, t. Hence we see that the E.M.F. induced in a closed circuit moving in a magnetic field, is measured by the *rate of change* of the number of lines of force enclosed, and is opposite in direction to that of the current which causes the motion. This result follows directly from the principle of conservation of energy, for if a current flowing in a given direction caused motion of the circuit, and this motion induced a current in the same direction as the original, it would increase the motion, and hence the energy of the system. Lenz's law, which says that if a current is induced in a magnetic field, it is in such a direction as to oppose by its electro-magnetic action, the cause inducing it is, therefore, directly deducible from the principle of conservation of energy.

(*To be continued.*)

ELECTRIC LIGHT.*

OF the beauty, the brilliancy of the electric light there is no question. It converts midnight into noonday. Although burning from points not larger than the little finger, it is distinctly visible at a distance of four miles at an ordinary elevation. And so pure and intensely white is it, that all other flames near it assume a red tinge from the contrast. We saw this extraordinary light burning not long ago on a bright sunny noon, and the bright rays of the sun which came streaming into the room appeared to have no effect upon it; it shone on as brilliantly as though it were twilight. A candle was lighted near it, and it was with difficulty that the tallow flame could be distinguished. On holding a burning taper between the electric light and the wall a deep black shadow was cast on it from the sickly flame of the taper, so completely was its illuminating power annihilated.

Electric light is produced by the juxtaposition of two points of carbon in the shape of pencils, through which are transmitted streams of positive and negative electricity. It had been found that during the powerful combustion of the carbon points they wore away, or consumed at an irregular rate; and hence the distance between them became greater or less at certain intervals, destroying thereby the equality of the light, which became more or less intense as the carbon points approached or receded from each other. To insure a proper condition of the light a regular distance was essential; if the points became too widely separated the flame expired; if they were forced too near, it deadened to a heavy dull glow. Mechanical contrivances of some ingenuity were tried to obviate this difficulty, but without avail, and it was not until Dr. Watson devised the beautiful method now employed, by which the points of carbon are made self-regulating, that a continuous and steady light was obtained.

The electric light, although triumphant as an illuminator, was at first too costly in its consumption of the raw materials of electricity to make it available for ordinary purposes. It may have been likened to some beautiful animal, which was found to consume far more food than it was worth. The electric animal swallowed too much iron, zinc, copper, acids, and salts, to pay for its work; it was not content with eating away its carbon points, but, like many a noble steed, "ate its head off."

Many plans were devised for cheapening the production of electricity, and this was partially compassed by the employment of cheaper metals in combination with the normal acids. The cheapest metals were found to be iron, lead, and zinc, but still the consumption of these with the chemicals employed outstripped the value of the electricity, and something more had to be achieved. For the purposes of an electric light it had been for some time ascertained that constancy and intensity in the battery employed were essentials: in other words, unless the stream of electricity was both regular and powerful, no effect would be produced. A battery of cast-iron and zinc arranged in such a way that the former is separated from the latter by a porous diaphragm of potter's biscuit-ware, the iron being excited by a mixture of saltpetre and sulphuric acid diluted by water, or by dilute nitrous acid and the zinc acted on by dilute sulphuric acid, affords great intensity. This is known as the Maynooth battery.

The products of such a battery as the above are, in addition to the electricity which is turned to account, several salts which have hitherto been thrown aside as valueless. These were the articles known to chemists as nitrate and sulphate of iron and sulphate of zinc, the latter being the white vitriol of commerce. The actual value of any of these salts is so trifling, and the demand for them so limited, that the residuary liquor of the Maynooth battery containing them may, for all practical purposes, be called worthless. It was evident that if this waste solution of the metals and acids could be turned to profitable account, the cost of the electricity would be proportionately reduced. To this object therefore, Dr. Watson directed all his energies.

The result of countless delicate and painstaking experiments has been the conversion of the hitherto refuse liquor of the Maynooth battery into articles of considerable commercial value. It was known that certain salts of iron and lead—that is to say, combinations of acids with those metals—precipitated in the form of salts, when mixed with certain chemicals, produced a number of beautiful pigments of great delicacy and purity. This was seized on as a means of employing to a profit the waste liquor of the battery, and the result showed that the plan of producing light and colour from the same elementary bodies was perfectly practicable. In this way the cast-iron and zinc apparatus of Maynooth was converted into a chromatic battery.

This process is as simple as it is beautiful. In the iron and zinc battery, nitric and sulphuric acids are employed in a diluted form, the ordinary resulting waste of which are solutions of nitrate of iron and sulphate of zinc. Instead of these residuary liquors being thrown aside as undeserving of care, they are removed separately from the chromatic battery, and, having been brought to a certain heat by means of steam, are blended with a solution of prussiate of potash, which, with the iron liquor, throws down a splendid blue pigment—Prussian blue, in fact, of great purity—whilst with the zinc liquor it precipitates a fine ultramarine blue.

After some agitation the colouring matter is allowed to subside, the clear liquor is drawn off, and, finally, the heavy deposition of blue is removed from the bottom of the vats and placed on cloth stretchers, whereon the moisture is allowed to drain from it. Subsequent pressure, and a final gradual drying in carefully heated chambers, completes the process, and the result is a pigment suitable for employment in the fine arts, for house decoration, or paper-colouring. It is difficult to conceive a deeper or more ethereal blue than the rich yet delicate ultramarine of the chromatic battery. Equally gorgeous are the electric reds produced by boiling the zinc yellow with lime in varying proportions, according to the depth of colour required. By a combination of these zinc yellows with the iron blues, a series of greens are produced of an infinity of shades, and which have the property of standing high temperatures without injury.

Yellows of great delicacy, ranging from pale lemon to a bright orange yellow, are produced by treating the waste liquor of the lead and nitric acid compartments of the battery with chromate of potash, which is, in plainer language, a salt composed of potash and chromic acid.

If, instead of the chromate, prussiate of potash be added to the residuum of the lead and zinc battery, a delicate white pigment will be the result, possessing, with great body, the property of not blackening by exposure to sulphuretted hydrogen gas, protected, as it appears to be, by the zinc-salt in the compound. In like manner, the addition of chromate of potash, instead of the prussiate, to the residuum of the iron battery yields a brown pigment of considerable depth.

In stating that the market value of these new colours far exceeds the whole cost of the original elements of the electro-chromatic battery, we do so from no desire to take a mere commercial view of the process—such would be altogether beside our purpose; but we mention the fact with a view to show what is of great importance to society—that by covering the cost of all the materials employed in these batteries by the conversion of their hitherto waste products into electro colours, the electricity developed during the process becomes a costless article—we have it gratis. Here, then, the great obstacle to the electric light is fairly overcome. That which before had been too costly, in spite of its utility, for general purposes, becomes at once a cheap commodity.

During a fog the ordinary red and green lights on railways are all but obscured, or if seen appear as of one colour, and trains are left to the chance of fog-signals. Through the heaviest fog that ever swallowed the metropolis in its murky jaws, the electric light shines in all its wonted midday brilliancy, heedless of heavy atmosphere. Along our dangerous coasts during winter months, how many ships are lost, how many lives are sacrificed, how many valuable cargoes destroyed from the want of a light sufficiently powerful to burst through the thick midnight haze of storm, and warn the voyager of the hidden danger ere it be too late. Surely in these cases interest and humanity would prompt the availing of this new and now cheap and simple light. It is worth while, too, to dwell upon the great simplicity of the electric lamp, which may be turned on and attended to by the most ordinary person; and insomuch as the electric light signals proposed to be employed do not depend on colour but on shape for their signification, there can be no confusion during the most foggy weather. A simple straight line of electric light denotes that all is right; a semicircle of brilliant rays to the left or right of the signal-post indicates the side on which danger presents itself, whilst an entire circle of light warns an approaching train to stop altogether.

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* *Household Words*, May, 1855.

Amongst those purposes to which cheap electricity may be applied is that of conveying semaphoric messages by night across the ocean, and thus avoiding the great cost of telegraph cables. Electric light is readily distinguishable for a distance of forty miles; and it is stated that, by a series of signal stations, many seas might be traversed by messages from one to the other, where islands or rocks offer connecting links.

As a cheap product for all purposes of electrotyping, it cannot but prove more acceptable, and not less so in one or two other branches of manufacture, which it may be interesting to mention. It was ascertained some time since that if the poles of a powerful battery be applied to a mass of coal undergoing the process of coking in an ordinary coke oven, in proportion as the coal loses its bituminous character and assumes the properties of coke, there is a greater facility afforded to the current of electricity for its passage, accompanied by a more rapid disengagement of the sulphur of the coal, and a greater and more effectual separation of the earthy and metallic impurities. Besides this, the coke thus produced, and, as it were, electrolysed, is much more compact, and consumes more equally than the material employed by the ordinary method. The importance of obtaining a coke free from sulphur for metallic manufactures and smelting processes is undeniable; equally desirable is it to obtain a large amount of carbon compressed within a small space for sea-going steamers. All these advantages have hitherto been forbidden by the costly nature of intense electricity; now that coke manufacturers can obtain their power at a trifling cost the whole feature of their process will be changed.

Again, our supplies of sulphur are derived from Sicily, the Government of which has recently forbidden the export of the article, which is consequently at an exorbitant price. We have no sulphur deposits in this country; but there exist large quantities of sulphur in close combination with iron, under the form of iron pyrites, in many parts of England. It has been found practicable to decompose this article, and obtain its sulphur and iron separate by smelting it with the aid of intense electricity; here again, the cost of the electric agent was the barrier, and here also cheap electricity comes to the rescue, and will shortly place this country independent of Sicily.

To the wholesale assayer of metals a cheap supply of intense electricity will be an inestimable boon; for it creates not only an enormous saving of fuel, but the six operations at present involved in the ordinary process may be reduced to one.

Cheap electricity will enable railway companies to electrolyse the tires of their engine and carriage wheels with a coating of steel, and thus avoid the great and incessant wear of the biting surface of the wheels, which, especially with their engines, require constant repair.

The quantity of bleaching material employed in this country is something enormous, and would doubtless sound incredible in the ears of the reader. An economical bleaching agent may be obtained by the decomposition of common salt in a state of solution, by means of electricity.

Should electro-magnetic engines be brought into practical working which many believe will be done, how great will be the advantage arising from a supply of almost costless electricity. The superiority of such machines for long sea voyages is at once apparent; and now that electricity for the million has been provided, it would appear more than ever desirable to bring them into use.

CHIP.

BRIMSTONE.

In stating, in the article on Electric Light, that there are no deposits of sulphur in this country, and that it derives its supplies wholly from Sicily, a correspondent is good enough to inform us that we overlooked the produce of the Irish mines.

It appears, from his statement, that the Wicklow mines have, for the last fifteen years, produced a large quantity of iron pyrites, containing about forty-five per cent. of sulphur; the produce has amounted, in part of that period, to one hundred thousand tons per annum, and is capable of increase. This ore has been extensively used by the various alkali manufacturers instead of Sicilian brimstone, and has greatly reduced the cost of the latter. It is now considered an important product, and has been the means of giving employment to great numbers of otherwise destitute persons. If this substitute for Sicilian brimstone had not been found that article would now be at an enormous price, instead of from five to six pounds sterling per ton.

THE LAMPE SOLEIL.

SINCE we described this lamp in our issues of June 17th and July 1st, 1882, it has undergone at the hands of M. Clerc, the inventor, a considerable amount of modification and improvement. The extent and nature of these alterations can only be seen by comparing the lamp of last year with that which we now describe and illustrate. It is to be regretted that so little has been done with the "Sun" lamp, for in steadiness it surpasses any system in which the voltaic arc is employed. This result, we need scarcely repeat, is due to the fixed and invariable position of the carbon rods, and to the additional constant light derived from the incandescent block of marble used in connection with these lamps.

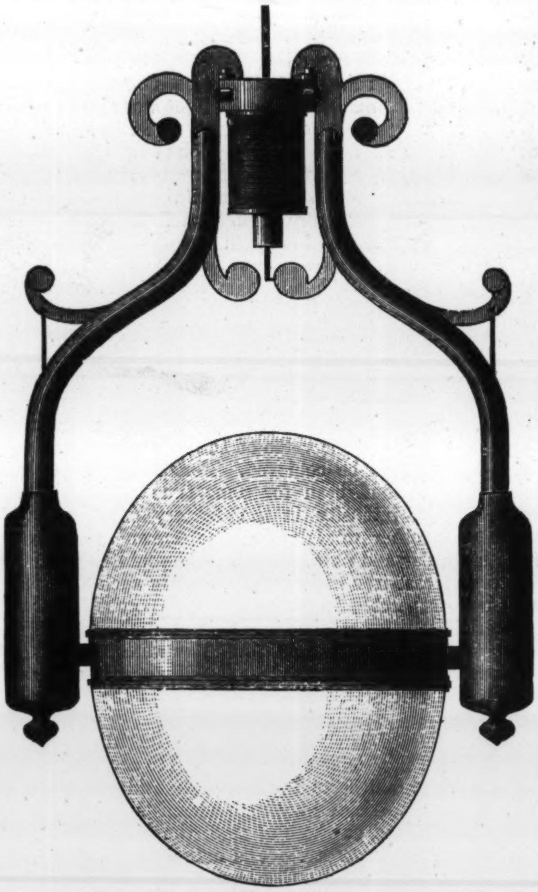

FIG 1.

The horse-power necessary to produce a given candle-power in the "Sun" lamp may be considerably higher than that required for other arc systems, but the great economy in the consumption of the carbon should be a set-off against extra engine-power. It is not, however, our intention to discuss these matters, but merely to describe briefly M. Clerc's improved form of lamp. Fig. 1 is a general view of the lamp, and fig. 2 shows the mechanism. The carbon rods, one of which is solid and the other drilled—for the purpose of allowing a small rod of carbon to be passed through, which makes contact with the end of the solid carbon, and which being withdrawn, either by hand or automatically, forms the arc between the two carbon rods—are placed horizontally, and as they consume they are gradually pressed forward by means of springs (easily traced in the figure) and which make short-circuit in the lamp when the carbons have been pushed to their distance limit. A safety switch is mounted on the upper portion of the lamp bracket, and through which the current passes by two paths.

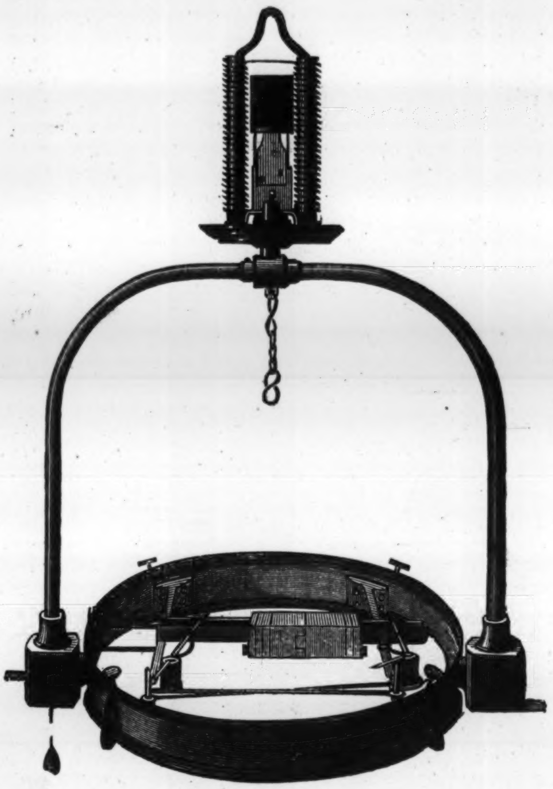

FIG. 2.

A portion goes along the German silver resistance coils, shown on each side, then through two mercury cups connected together by means of a metal fork attached to a soft iron core, and from thence to line; the other part traverses the main circuit consisting of a short coil of moderately thick copper wire, then the drilled carbon rod, across the connecting projection of the small carbon pencil to the other carbon and to line. The effect is that the soft iron core is pulled into the main circuit coil, and the metal fork being lifted out of the mercury cups the derived circuit is broken. Should any accident occur to the working parts of the lamp, such as an extinction and being unable to re-light, the core drops again, the circuit is completed, and the remainder of the lamps on the same line are unaffected. The main circuit coil is shown in detail in fig. 3, together with the mercury cups.

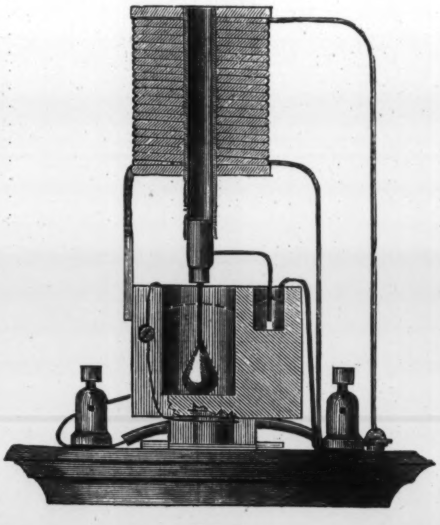

FIG. 3.

Fig. 4 is a sketch of the carbon rods and the carbon pencil, which passes through the hollow one for the purpose of igniting and re-lighting. As mentioned above, this is either accomplished by pulling a string, lifting a weight, or automatically by electrical means, and therefore it is quite unnecessary to enter into minute details as regards this portion of the apparatus. We trust that the illumination of a portion of South Kensington Museum with the 40 lamps we mentioned in our last issue will terminate successfully, and that through this means the Sun Lamp and Power Company may be enabled to bring this beautiful light into greater prominence than heretofore. The type of lamp devised for workshop and factory use is most simple and must necessarily be extraordinarily cheap, and it should therefore attract more attention amongst engineers, shipbuilders, mill owners, and others of like pursuits than it has yet had accorded.

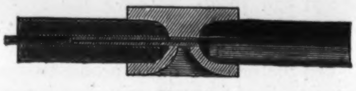

FIG. 4.

ELECTRIC LIGHTING AT THE CHICAGO EXHIBITION.

FIVE companies exhibited apparatus, and contributed to the lighting of the building and grounds. These were the United States Company, the Edison Company, the Brush Company, the Fuller Company, and the Thomson-Houston Company (formerly the American Company, of New Britain, Conn.). The main building, with its various annexes, and the outside spaces, were lighted with about 500 arc lights. Of these, the Thomson-Houston Company furnished about 30 or 40, and the remainder were about equally divided between the Fuller, the United States, and the Brush Companies. Between 600 and 700 incandescent lights were used in the small rooms and offices and in the booths of different exhibitors, of which the Edison Company and the United States Company each contributed about one-half. The companies exhibited only a limited number of lights to show the working of their apparatus, and the remaining lights were paid for by the Exhibition Association.

The exhibit of the United States Company was larger and more complete than any of the others, as it embraced not only arc and incandescent lighting, but also electrical transmission of power. One of the most attractive of the exhibits was a cascade supplied with water by a centrifugal pump, driven by a Weston motor, and illuminated by Maxim incandescent lamps placed behind the sheet of falling water. A Weston dynamo and motor were also used for running the electric railway.

The Weston arc lights and the Thomson-Houston arc lights attracted much attention by their remarkable steadiness and high illuminating power. The Fuller lights were not so powerful and far less steady. This appeared to be due, in great measure, to putting more lights on the machines than they could run properly. The Brush arc lights were conspicuously bad. They were feeble, uneven, and unsteady. There appeared to be a surprising lack of care in the erection and management of the Brush exhibit. The circuits were run in a very slipshod way, the lamps were placed at irregular intervals, and even the globes for the lamps were apparently, in many instances, improvised out of porcelain shades made for argand burners.

The absence of the Brush storage battery from the exhibition was the subject of much comment. A few Swan lamps were shown, and the chandeliers upon which these were placed were labelled "The Brush-Swan system of electrical storage, light, and power," but the lamps were apparently run directly from a small Brush dynamo, and careful inquiry failed to discover any storage battery.

The Edison incandescent lights and the Maxim incandescent lights both worked extremely well, and the exhibition of incandescent lighting was very creditable to both companies.

The electric railway was one of the most popular features. A circular track was erected around the gallery of the main building, and upon this was placed an electric locomotive and a car carrying 30 or 40 passengers. The current was carried to the motor on the locomotive through the rails, and a third rail placed between the two main rails. Although all the work was done hurriedly, in the last week or two before the exhibition opened, and the appliances used for controlling the motor were quite crude, the railway, on the whole, worked well, and was examined with great interest by many prominent railroad men.

In the prospectus of the exhibition a gold medal was offered for the best system of lighting depôts, shops, and yards by electricity, and to this were afterward added gold medals for the best arc system and the best incandescent system. All the exhibitors, except the Brush company, entered into competition for these awards, but afterwards united in requesting that thorough scientific tests and measurements of the different systems be made by an expert jury, and that the report of the jury be substituted for the awards proposed. A jury has been appointed, consisting of Prof. Henry Morton, of Stevens Institute; Prof. Charles R. Cross, of the Massachusetts Institute of Technology; Prof. B. F. Thomas, of the University of Missouri; Mr. L. F. Leyne, of the *American Machinist*, and Prof. James Denton, of Stevens Institute. The tests are to be made at New York before the 1st of September. The Brush Company has been invited by the other companies to join in the tests, and will probably do so.

"We think," says the New York *Electrician*, "the electric light companies have acted wisely in waiving the awards, and arranging for thorough tests. Nothing is more unsatisfactory than awards based upon mere cursory examination of complicated apparatus shown at an exhibition, and both the public and the electric light companies will be greatly benefited by a thorough and impartial examination of the real merits of the different systems."

ELECTRIC LIGHT AND POWER CONDUCTORS.

Tables showing Energy absorbed in Watts and Horse-power by 1,000 *feet of Copper Conductor of different diameters when transmitting electrical currents of from* 20 *to* 500 *ampères. Conductivity* 95 *per cent. of pure copper. Temp.* 60 *Fah.**

By E. W. BECKINGSALE.

Sec. Area.	Resistance of 1,000 feet.		20 ampères.		25 ampères.	
			Energy absorbed by Conductor.			
Sq. in.	Ohms.	Reciprocals	Watts.	H.P.	Watts.	H.P.
·95	·008979	111·371	3·5916	·00481	5·6119	·00752
·90	·009477	105·519	3·7910	·00508	5·9231	·00794
·85	·010035	99·651	4·0140	·00538	6·2719	·00841
·80	·010662	93·789	4·2649	·00572	6·6638	·00893
·75	·011373	87·927	4·5493	·00610	7·1082	·00953
·70	·012185	82·065	4·8742	·00653	7·6156	·01021
·65	·013123	76·203	5·2492	·00704	8·2019	·01100
·60	·014217	70·341	5·6866	·00762	8·8856	·01191
·55	·015509	64·479	6·2036	·00832	9·6931	·01299
·50	·017060	58·617	6·8240	·00915	10·662	·01429
·45	·018955	52·756	7·5820	·01016	11·847	·01588
·40	·021325	46·895	8·5299	·01143	13·328	·01786
·35	·024371	41·033	9·7484	·01307	15·232	·02042
·30	·028433	35·171	11·373	·01525	17·771	·02382
·25	·034120	29·308	13·648	·01830	21·325	·02859
·20	·042649	23·447	17·060	·02287	26·656	·03573
·15	·056866	17·585	22·746	·03049	35·541	·04764
·10	·085299	11·723	34·120	·04574	53·312	·07146

Sec. Area.	30 ampères.		35 ampères.		40 ampères.	
	Energy absorbed by Conductor.					
Sq. in.	Watts.	H.P.	Watts.	H.P.	Watts.	H.P.
·95	8·0811	·01083	10·999	·01474	14·366	·01926
·90	8·5299	·01143	11·610	·01556	15·164	·02033
·85	9·0315	·01211	12·293	·01648	16·056	·02152
·80	9·5958	·01286	13·061	·01751	17·060	·02286
·75	10·236	·01372	13·932	·01868	18·197	·02439
·70	10·966	·01470	14·928	·02001	19·497	·02614
·65	11·811	·01583	16·076	·02155	20·997	·02815
·60	12·795	·01715	17·416	·02334	22·746	·03049
·55	13·958	·01871	18·999	·02547	24·814	·03326
·50	15·354	·02058	20·899	·02801	27·296	·03659
·45	17·059	·02287	23·220	·03113	30·328	·04066
·40	19·192	·02573	26·123	·03502	34·119	·04574
·35	21·934	·02940	29·855	·04002	38·994	·05227
·30	25·590	·03430	34·831	·04609	45·493	·06098
·25	30·708	·04116	41·797	·05603	54·592	·07318
·20	38·385	·05146	52·246	·07004	68·239	·09147
·15	51·179	·06860	69·662	·09338	90·936	·12196
·10	76·769	·10291	104·49	·14007	136·48	·18294

Sec. Area.	Resistance of 1,000 feet.		45 ampères.		50 ampères.	
			Energy absorbed by Conductor.			
Sq. in.	Ohms.	Reciprocals	Watts.	H.P.	Watts.	H.P.
·95	·008979	111·371	18·182	·02437	22·448	·03009
·90	·009477	105·519	19·192	·02573	23·693	·03176
·85	·010035	99·651	20·321	·02724	25·088	·03363
·80	·010662	93·789	21·591	·02894	26·655	·03573
·75	·011373	87·927	23·030	·03087	28·432	·03811
·70	·012185	82·065	24·675	·03308	30·463	·04084
·65	·013123	76·203	26·574	·03562	32·807	·04398
·60	·014217	70·341	28·788	·03859	35·540	·04764
·55	·015509	64·479	31·405	·04210	38·772	·05198
·50	·017060	58·617	34·545	·04631	42·650	·05717
·45	·018955	52·756	38·389	·05145	47·387	·06353
·40	·021325	46·895	43·182	·05788	53·311	·07146
·35	·024371	41·033	49·350	·06615	60·927	·08167
·30	·028433	35·171	57·576	·07718	71·082	·09529
·25	·034120	29·308	69·091	·09262	85·300	·11434
·20	·042649	23·447	86·363	·11577	106·62	·14293
·15	·056866	17·585	115·15	·15436	142·16	·19057
·10	·085299	11·723	172·73	·23154	213·25	·28585

Sec. Area.	55 ampères.		60 ampères.		65 ampères.	
	Energy absorbed by Conductor.					
Sq. in.	Watts.	H.P.	Watts.	H.P.	Watts.	H.P.
·95	27·161	·03641	32·324	·04333	37·936	·05085
·90	28·670	·03843	34·118	·04573	40·043	·05368
·85	30·356	·04069	36·126	·04843	42·398	·05683
·80	32·253	·04323	38·383	·05146	45·048	·06037
·75	34·395	·04611	40·944	·05488	48·052	·06441
·70	36·861	·04941	43·868	·05880	51·484	·06901
·65	39·696	·05321	47·243	·06333	55·445	·07432
·60	43·004	·05765	51·179	·06860	60·065	·08052
·55	46·914	·06289	55·832	·07484	65·525	·08784
·50	51·605	·06918	61·416	·08233	72·077	·09662
·45	57·339	·07686	68·236	·09147	80·087	·10735
·40	64·506	·08647	76·766	·10291	90·097	·12077
·35	73·721	·09882	87·736	·11761	102·97	·13803
·30	86·008	·11529	102·36	·13721	120·13	·16103
·25	103·21	·13835	122·83	·16465	144·15	·19324
·20	129·01	·17294	153·54	·20582	180·20	·24155
·15	172·02	·23058	204·72	·27442	240·26	·32206
·10	258·03	·34588	307·08	·41164	360·39	·48309

Sec. Area.	Resistance of 1,000 feet.		70 ampères.		75 ampères.	
			Energy absorbed by Conductor.			
Sq. in.	Ohms.	Reciprocals	Watts.	H.P.	Watts.	H.P.
·95	as above	as above	43·996	·05898	50·506	·06770
·90			46·440	·06225	53·316	·07147
·85			49·172	·06592	56·448	·07567
·80			52·246	·07003	59·976	·08040
·75			55·729	·07470	63·975	·08576
·70			59·710	·08004	68·539	·09188
·65			64·304	·08620	73·816	·09896
·60			69·662	·09338	79·967	·10719
·55			75·996	·10186	87·237	·11695
·50			83·594	·11205	95·962	·12864
·45			92·880	·12451	106·62	·14293
·40			104·491	·14007	119·95	·16079
·35			119·420	·16008	137·09	·18376
·30			139·324	·18676	159·94	·21439
·25			167·188	·22411	191·92	·25727
·20			208·982	·28014	239·90	·32158
·15			278·648	·37352	319·87	·42879
·10			417·964	·56028	479·81	·64317

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* The standard of resistance used in calculating the above tables is ·1516 ohm. which, according to Dr. Matthiessen, is the resistance at 60 Fah. of 100 inches of pure annealed copper weighing 100 grains; 555 lbs. is taken to be the weight of 1 cubic foot of pure copper.

Sec. Area	80 ampères.		85 ampères.		90 ampères.	
	Energy absorbed by Conductor.					
Sq. in.	Watts.	H.P.	Watts.	H.P.	Watts.	H.P.
·95	57·466	·07703	64·872	·08696	72·728	·09749
·90	60·656	·08131	68·476	·09179	76·768	·10291
·85	64·224	·08609	72·504	·09719	81·284	·10896
·80	68·239	·09147	77·035	·10326	86·365	·11577
·75	72·789	·09757	82·171	·11015	92·121	·12349
·70	77·987	·10454	88·040	·11802	98·700	·13231
·65	83·987	·11258	94·813	·12710	106·30	·14248
·60	90·986	·12196	102·71	·13769	115·15	·15436
·55	99·257	·13305	112·05	·15020	125·62	·16839
·50	109·18	·14636	123·26	·16522	138·18	·18523
·45	121·31	·16262	136·95	·18358	153·54	·20581
·40	136·48	·18294	154·07	·20653	172·73	·23154
·35	155·97	·20909	176·38	·23603	197·40	·26461
·30	181·97	·24392	205·43	·27537	230·30	·30872
·25	218·37	·29272	246·51	·33045	276·36	·37046
·20	272·96	·36589	308·14	·41306	345·46	·46308
·15	363·94	·48784	410·86	·55074	460·60	·61744
·10	545·91	·73178	616·28	·82611	690·92	·92616

Sec. Area.	Resistance of 1,000 ft.		95 ampères.		100 ampères.	
			Energy absorbed by Conductor.			
Sq. in.	Ohms.	Reciprocals	Watts.	H.P.	Watts.	H.P.
·95			81·035	·10863	89·792	·12036
·90			85·536	·11466	94·772	·12705
·85			90·484	·12140	100·35	·13452
·80			96·228	·12899	106·62	·14293
·75			102·64	·13759	113·73	·15245
·70			109·98	·14742	121·85	·16334
·65			118·43	·15876	131·23	·17592
·60			128·30	·17199	142·16	·19057
·55	as above	as above	139·97	·18763	155·09	·20790
·50			153·96	·20639	170·60	·22869
·45			171·07	·22932	189·55	·25410
·40			192·46	·25793	213·24	·28585
·35			219·95	·29484	243·71	·32662
·30			256·61	·34398	284·33	·38114
·25			307·93	·41277	341·20	·45738
·20			384·91	·51597	426·49	·57170
·15			513·22	·68795	568·66	·76229
·10			769·82	1·0319	852·99	1·1434

Sec. Area.	120 ampères.		140 ampères.		160 ampères.	
	Energy absorbed by a Conductor.					
Sq. in.	Watts.	H.P.	Watts.	H.P.	Watts.	H.P.
·95	129·30	·17333	175·98	·23590	229·86	·30813
·90	136·47	·18294	185·76	·24902	242·62	·32525
·85	144·50	·19371	196·69	·26366	256·90	·34436
·80	153·54	·20582	208·98	·28014	272·96	·36589
·75	163·78	·21954	222·02	·29881	291·16	·39029
·70	175·47	·23522	238·84	·32015	311·95	·41818
·65	188·97	·25333	257·22	·34478	335·95	·45033
·60	204·72	·27442	278·65	·37352	363·94	·48784
·55	223·33	·29937	303·98	·40746	397·03	·53221
·50	245·66	·32930	334·38	·44822	436·74	·58544
·45	272·94	·36587	371·52	·49803	485·25	·65050
·40	307·08	·41164	417·96	·56028	545·91	·73178
·35	350·94	·47043	477·68	·64030	623·90	·83635
·30	409·43	·54883	557·30	·74703	727·88	·97568
·25	491·33	·65861	668·75	·89643	873·47	1·1709
·20	614·15	·82328	835·93	1·1206	1091·8	1·4636
·15	818·87	1·0977	1114·6	1·4941	1455·8	1·9514
·10	1228·3	1·6466	1671·9	2·2411	2183·7	2·9271

Sec. Area.	Resistance of 1,000 feet.		180 ampères.		200 ampères.	
			Energy absorbed by Conductor.			
Sq. in.	Ohms.	Reciprocals	Watts.	H.P.	Watts.	H P.
·95			290·91	·38995	359·16	·48145
·90			307·07	·41162	379·10	·50820
·85			325·14	·43584	401·40	·53807
·80			345·46	·46308	426·49	·57170
·75			368·49	·49395	454·93	·60983
·70			394·80	·52922	487·42	·65334
·65			425·18	·56994	524·92	·70364
·60			460·60	·61744	568·66	·76225
·55	as above	as above	502·48	·67357	620·36	·83158
·50			552·73	·74092	682·40	·91475
·45			614·14	·82325	758·20	1·0164
·40			690·92	·92616	852·99	1·1434
·35			789·60	1·0584	974·84	1·3068
·30			921·20	1·2349	1137·3	1·5245
·25			1105·46	1·4818	1364·8	1·8295
·20			1381·84	1·8523	1706·0	2·2868
·15			1842·40	2·4698	2274·6	3·0490
·10			2763·7	3·7046	3412·0	4·5736

Sec. Area.	220 ampères.		240 ampères.		260 ampères.	
	Energy absorbed by Conductor.					
Sq. in.	Watts.	H.P.	Watts.	H.P.	Watts.	H.P.
·95	434·57	·58253	517·19	·69331	606·97	·81363
·90	458·71	·61489	545·89	·73174	640·69	·85884
·85	485·69	·65106	578·02	·77485	678·38	·90935
·80	516·05	·69175	614·15	·82328	720·78	·96618
·75	550·45	·73787	655·10	·87814	768·83	1·0306
·70	589·75	·79060	701·88	·94086	823·74	1·1042
·65	635·14	·85139	755·88	1·0133	887·12	1·1892
·60	688·07	·92234	818·87	1·0977	961·04	1·2883
·55	750·62	1·0062	894·92	1·2083	1048·4	1·4054
·50	825·68	1·1068	982·66	1·3172	1153·2	1·5459
·45	917·43	1·2298	1091·8	1·4635	1281·4	1·7177
·40	1032·1	1·3835	1228·3	1·6466	1441·5	1·9324
·35	1179·5	1·5812	1503·8	1·8817	1647·5	2·2084
·30	1376·0	1·8447	1637·7	2·1953	1922·1	2·5765
·25	1651·4	2·2136	1965·3	2·6344	2306·5	3·0918
·20	2064·2	2·7670	2456·6	3·2931	2883·1	3·8647
·15	2752·1	3·6894	3275·5	4·3906	3844·2	5·1530
·10	4128·4	5·5340	4913·2	6·5862	5766·2	7·7295

Sec. Area.	Resistance of 1,000 feet.		280 ampères.		300 ampères.	
			Energy absorbed by Conductor.			
Sq. in.	Ohms.	Reciprocals	Watts.	H.P.	Watts.	H.P.
·95			703·94	·94362	808·11	1·0833
·90			743·04	·99606	852·99	1·1434
·85			786·75	1·0546	903·15	1·2107
·80			835·93	1·1205	959·61	1·2863
·75			891·67	1·1952	1023·5	1·3721
·70			955·36	1·2806	1096·6	1·4701
·65			1028·9	1·3791	1181·1	1·5833
·60			1114·6	1·4941	1279·5	1·7151
·55	as above	as above	1215·9	1·6298	1395·8	1·8710
·50			1337·5	1·7929	1535·4	2·0581
·45			1486·1	1·9921	1705·9	2·2867
·40			1671·9	2·2411	1919·2	2·5727
·35			1910·7	2·5612	2193·4	2·9402
·30			2229·2	2·9881	2559·0	3·4302
·25			2675·0	3·5857	3070·8	4·1163
·20			3343·7	4·4822	3838·5	5·1455
·15			4458·4	5·9762	5117·9	6·8604
·10			6687·4	8·9645	7676·9	10·291

Sec. Area.	320 ampères.		340 ampères.		360 ampères.	
	Energy absorbed by Conductor.					
Sq. in.	Watts.	H.P.	Watts.	H.P.	Watts.	H.P.
·95	919·45	1·2325	1038·0	1·3914	1163·6	1·5598
·90	970·50	1·3010	1095·6	1·4687	1228·3	1·6465
·85	1027·5	1·3774	1160·1	1·5550	1300·5	1·7434
·80	1091·8	1·4635	1232·6	1·6522	1381·8	1·8523
·75	1164·6	1·5612	1314·7	1·7620	1473·9	1·9758
·70	1247·8	1·6727	1408·6	1·8883	1579·2	2·1169
·65	1343·8	1·8013	1517·0	2·0335	1700·7	2·2797
·60	1455·8	1·9514	1643·4	2·2030	1842·4	2·4698
·55	1588·1	2·1288	1792·8	2·4033	2009·9	2·6943
·50	1746·9	2·3418	1972·1	2·6430	2210·9	2·9637
·45	1941·0	2·6020	2191·3	2·9373	2456·6	3·2930
·40	2183·6	2·9271	2465·1	3·3044	2763·7	3·7046
·35	2495·6	3·3455	2817·3	3·7766	3158·4	4·2338
·30	2911·5	3·9027	3286·8	4·4059	3684·8	4·9395
·25	3493·9	4·6835	3944·2	5·2859	4421·8	5·9274
·20	4367·3	5·8542	4930·2	6·6089	5527·4	7·4093
·15	5823·1	7·8054	6573·7	8·8119	7369·6	9·8790
·10	8734·6	11·708	9860·5	13·218	11054·0	14·819

Sec. Area.	Resistance of 1,000 feet.		380 ampères.		400 ampères.	
			Energy absorbed by Conductor.			
Sq. in.	Ohms.	Reciprocals	Watts.	H.P.	Watts.	H.P.
·95			1296·6	1·7380	1436·6	1·9258
·90			1368·6	1·8345	1516·4	2·0328
·85			1449·1	1·9425	1605·6	2·1523
·80			1539·6	2·0639	1706·0	2·2868
·75			1642·3	2·2015	1819·7	2·4393
·70			1759·6	2·3587	1949·7	2·6136
·65			1895·0	2·5402	2099·7	2·8146
·60			2052·9	2·7518	2274·6	3·0490
·55	as above	as above	2239·5	3·0020	2481·4	3·3263
·50			2463·4	3·3022	2729·6	3·6590
·45			2737·2	3·6691	3032·8	4·0656
·40			3079·3	4·1277	3411·9	4·5736
·35			3519·2	4·7174	3899·4	5·2272
·30			4105·7	5·5037	4549·3	6·0980
·25			4926·9	6·6044	5459·2	7·3180
·20			6158·6	8·2554	6823·9	9·1472
·15			8211·4	11·007	9098·6	12·196
·10			12317·0	16·511	13648·8	18·294

Sec. Area.	420 ampères.		440 ampères.		460 ampères.	
	Energy absorbed by Conductor.					
Sq. in.	Watts.	H.P.	Watts.	H.P.	Watts.	H.P.
·95	1583·9	2·1231	1738·3	2·3301	1900·0	2·5468
·90	1671·8	2·2411	1834·9	2·4596	2005·5	2·6883
·85	1770·2	2·3729	1942·8	2·6042	2123·4	2·8464
·80	1880·9	2·5212	2064·2	2·7670	2256·2	3·0243
·75	2006·2	2·6893	2201·0	2·9515	2406·6	3·2260
·70	2149·5	2·8814	2259·0	3·1624	2578·5	3·4564
·65	2314·9	3·1031	2540·6	3·4056	2776·8	3·7223
·60	2507·7	3·3617	2752·1	3·6894	3008·2	4·0325
·55	2735·8	3·6673	3002·5	4·0248	3281·7	4·3991
·50	3009·3	4·0339	3302·8	4·4272	3609·9	4·8389
·45	3343·7	4·4822	3669·7	4·9192	4011·0	5·3766
·40	3761·7	5·0425	4128·4	5·5340	4512·3	6·0487
·35	4299·0	5·7628	4718·0	6·3248	5156·9	6·9127
·30	5015·5	6·7235	5504·2	7·3788	6016·5	8·0650
·25	6018·7	8·0679	6605·6	8·8544	7219·7	9·6779
·20	7523·5	10·085	8256·8	11·068	9024·6	12·098
·15	10031·0	13·447	11008·0	14·758	12033·0	16·130
·10	15047·0	20·170	16514·0	22·136	18049·0	24·195

Sec. Area.	Resistance of 1,000 feet.		480 ampères.		500 ampères.	
			Energy absorbed by Conductor.			
Sq. in.	Ohms.	reciprocals.	Watts.	H.P.	Watts.	H.P.
·95			2068·8	2·7732	2244·8	3·0091
·90			2183·5	2·9270	2369·3	3·1763
·85			2312·1	3·1034	2508·8	3·3630
·80			2456·6	3·2931	2665·5	3·5731
·75			2620·4	3·5126	2843·2	3·8115
·70			2807·5	3·7634	3046·3	4·0836
·65			3023·5	4·0532	3280·7	4·3980
·60			3275·5	4·3907	3554·0	4·7643
·55	as above	as above	3579·7	4·8334	3877·2	5·1976
·50			3930·6	5·2689	4265·0	5·7172
·45			4367·1	5·8539	4738·7	6·3526
·40			4913·2	6·5862	5331·1	7·1463
·35			6015·1	7·5269	6092·7	8·1672
·30			6551·0	8·7813	7108·2	9·5286
·25			7861·2	10·538	8530·0	11·434
·20			9826·4	13·172	1066·2	14·293
·15			13102·0	17·563	14216·0	19 057
·10			19653.0	26·345	21325·0	28·585

ON THE APPLICATION OF AMPÈRE'S METHOD TO THE ESTABLISHMENT OF THE ELEMENTARY LAW OF INDUCTION BY DISPLACEMENT.

By M. QUET.

I HAVE previously shown that the laws of induction by displacement may be established as corollaries of electrodynamics, and I have attained this object very rapidly by taking my stand on the generally admitted hypothesis of the inner constitution of currents. Still, as we have here to do with laws admitting of numerous and important applications, it seemed useful to get rid of this kind of hypothesis, and I believe that I have reached this result by means of the celebrated experimental method of Ampère.

1. *General Hypothesis.*—I admit that the action of an element of current upon an elementary mass of electric fluid animated with any relative speed consists in an attraction or a repulsion, *i.e.*, in a force the direction of which passes by the centres of the two elements. This hypothesis, which is the most simple of all and which is an imitation of those of Newton and of Ampère, gives the direction of the force of induction of which it is merely needful to determine the magnitude.

2. *Proposition.*—The force of induction is null when the direction of the element of the current being perpendicular to the line of the centres, the relative speed of the induced element follows this line. In fact, if we cause to revolve around the line of the centres, $o\ c$, the plane passing through it and through the direction, $d\ s'$, of the element of the inducing current, the force, g, which is applied to the mass, m, in the direction, $o\ c$, will remain the same for all the positions of the plane by reason of the symmetry of the space. The action upon m will then become $2\ g$, if we cause to act at once two elements of equal currents, the one occupying the first position of $d\ s'$, and the other that which $d\ s'$ takes after a semi-revolution of the plane. But then, the two elements of the current being equal, superimposed and in opposite directions, will counterbalance each other, and we have $2\ p = 0$, or $p = 0$. It will be easy to ascertain, by using a conductor folded back upon itself, that equal currents, superimposed and opposite in direction, have equal and contrary actions.

3. *General Principle.*—The force, g, may be considered as the resultant of the actions exerted upon m, by the projections of the inducing element ($c\ i'$, $d\ i'$) taken with reference to three rectangular directions carried through its centre, c. This principle, which is not doubtful, can be verified by experiments made with a wire bent in the form of a polygon the sides of which deviate little from the original direction of the wire.

The force, g, is equal to the resultant of the actions which the element of the current, $d\ s'$, would exert upon the mass, m, if this were animated by turns, by speeds equal to the projections of its proper speed, v, upon three rectangular axes.

It follows from this general principle that the force, g, may be replaced by nine components which are reduced at first to six, when we have chosen the axes of projection as did Ampère in an analogous question, and ultimately to two only if we have regard to the second proposition. These two components are: the action, g', which the projection, $d\ s'$, cos θ' of $d\ s'$, upon $o\ c$, exerts upon the mass, m, animated with the speed, $v \cos \theta$, the projection of v upon the line of the centres and the action g'', which the projection $d\ s'$ sine θ' of $d\ s'$ upon the perpendicular to $o\ c$, in the plane $o\ c\ d\ s'$, exerts upon m, supposed as actuated by the speed, v sine $\theta \cos \gamma$, projection of v upon the direction perpendicular to $o\ c$, in the preceding plane. We have $g = g' + g''$.

4. *Experimental Proposition.*—The inductive action is proportional to the velocity, v, of the element, m. This results from old experiments as well as from a great number of experiments made latterly. This action is proportional, as it is easy to see, to the intensity, i''.

Accordingly, if we call $f\ (r)$ and $\mathrm{F}\ (r)$ two unknown fractions of the distance, r, from the centres of the elements, we have $g = m\ v\ i'\ d\ s'\ [\sin \theta \sin \theta' \cos \gamma\ f\ (r) + \cos \theta \sin \theta'\ \mathrm{F}\ (r)]$.

5. *Experimental Proposition.*—The action exerted by any system whatever of closed currents upon an elementary mass, m, in motion is perpendicular to the direction, $o\ v$, of the velocity, v, of this mass.

This proposition follows from old and known experiments, and will be submitted to new verifications. Its consequence is that we should have—

$$\mathrm{F}(r) = \tfrac{1}{2}\ \frac{d}{d\ r}\ [r\ f\ (r)].$$

6. *Experimental Proposition.*—A homogeneous solenoid, the directive of which is a closed curve, exerts no induction upon a conductor in movement. The proposition is not doubtful, but will nevertheless be submitted to experiment. This proposition joined to the former requires that $f\ (r)$ should be equal to the quotient of a constant, k', divided by r^2, when the force cannot become infinite with the distance. This result and the former are obtained without new calculations, because questions completely analogous have been treated in electrodynamics. We have thus:

$$f\ (r) = \frac{k'}{r^2},\quad \mathrm{F}\ (r) = -\frac{k'}{2r^2},$$

$$g = \frac{k'\ m\ v\ i'\ d\ i'}{r^2}\ (\sin \theta \sin \theta' \cos \gamma - \tfrac{1}{2} \cos \theta \cos \theta').$$

The latter of these formulæ gives the elementary law of electric induction by displacement; it shows clearly that the questions relative to this kind of induction are connected with the problems of electrodynamics. G is the electrodynamic action exerted by the element of the current ($c\ i'$, $d\ s'$) upon an element of the current ($o\ i\ d\ s$), placed at the same point, o, as the mass, m, and having for its direction that of the velocity of this mass or $o\ v$. Ampère's formula gives—

$$\mathrm{G} = \frac{k\ i\ i'\ d\ s\ d\ s'}{r^2}\ (\sin \theta \sin \theta' \cos \gamma - \tfrac{1}{2} \cos \theta \cos \theta')$$

If we compare g to G and put $k' = h\,k$, $m\,v = H\,i\,d\,s$, we have $g = H\,G$ and the ratio, H, is independent of $r\,\theta\,\theta'\,\gamma\,i'\,d\,s'$.

I consider any system whatever of closed currents or portions of currents, and I cause it to act by turns upon m by induction, and upon $d\,s$ by electrodynamic action. If we resolve these currents into their elements, $a, a', a'', \ldots$ whose centres are $c, c', c'', \ldots$ we shall have two groups of forces, $g, g', g'' \ldots$; G, G', G''; the corresponding forces of these two groups $(g\,G), (g'\,G') \ldots$ have as their common directions the lines $o\,c, o\,c', o\,c'' \ldots$ and their intensities have a mutual relation which is constant and equal to H, since $g = H\,G$, $g' = H\,G'$, $g'' = H\,G'' \ldots$ Hence it follows that the resultants, p, of the forces of induction, $g, g' \ldots$ and F of the electrodynamic forces, $G, G', G'' \ldots$ have the same direction and have among themselves a ratio $= H$, therefore, $p = H\,F$.

The intensity, i, of the current supposed in $d\,s$ and the length, $d\,s$, are two arbitrary magnitudes; they may be selected in such a manner that $i\,d\,s = 2\,m\,v$; then $H = \frac{1}{2}\,h$ and $p = h\,\frac{1}{2}\,F$. It follows that the force of induction, p, has the same direction as the electrodynamic action exerted by the system upon an element of current placed in o in the direction $o\,v$, and that its intensity is equal to the product of a constant by the half of the electrodynamic action which would take place if $i\,d\,s = 2\,m\,v$. In certain problems it would be useless to know the value of the constant, h. If it is wished for we might recur to the hypothesis relative to the constitution of currents. The foregoing formulæ would then show at once that $h = 1$, or $k' = k$.—*Comptes Rendus.*

NOTES.

Electric Lighting.—In a circular issued by Shippey Bros., electrical engineers and light contractors, we notice the following statement concerning the "Universal" incandescence electric lamps, upon which subject we have commented before. "These lamps are the cheapest and most economical yet introduced for domestic lighting. They diffuse a pure, soft, and beautiful brilliant light, and when placed in the same circuit with either the Swan, Edison, or other incandescent systems they are easily discernible by their extra brilliancy, which is obtained from a patented process adopted in the manufacture of the carbon filaments used for the Universal lamp, made from purified moss of the finest quality, &c." Messrs. Shippey Bros. also make a special announcement that they have eminent electricians connected with them. It seems a pity that one or more of these electricians were not consulted as to whether the extra brilliancy of the Universal lamp is due to the cause stated above. We ourselves explain it by a method of reasoning which, if not convincing to Messrs. Shippey, will, at all events, satisfy electricians who have yet to attain eminence. The lamp in question has a resistance of only 20 ohms when cold; Swan's and Edison's are of course much higher, and advantageously so. When the Universal lamp is placed in circuit with the others it naturally robs the higher resistance lamps of their due allowance of current, with the effect of causing an inexperienced observer to believe that the Swan and Edison systems have been misrepresented, and that the "Universal" is really economical. We should like to know whether such statements as that quoted are made through ignorance or something worse. We are charitable enough to suppose the former to be the reason. Will Messrs. Shippey Bros. inform us whether or not the lamp they represent is that patented by Zanni, and having a platinum core inside the carbon filament?

In consequence of the satisfaction given by the electric light on the s.s. *Burwah*, the Electric Carbon, Storage, and Apparatus Manufacturing Company of Scotland has received instructions to light up the s.s. *Gabo*, for Melbourne. 100 incandescent lamps and two arc lamps will be used in this installation, Higgs' self-regulating dynamo machine, as in the case of the *Burwah*, being employed.

In the House of Commons, on Thursday of last week, on the Order for the second reading of the Electric Lighting (No. 8) Bill, Mr. Warton moved that the Bill be read a second time that day three months, on the ground that there were already too many of these measures dealing experimentally with a science which was still in its infancy. Mr. Stevenson hoped that no hindrance would be offered to experiments of so much importance to the public. Lord A. Percy opposed the Bill as tending to create inconvenience and interfere with the powers of the local authority, by the partial lighting of a district which might otherwise be more effectually lighted altogether by a competing company. Mr. Chamberlain said what was proposed was, that if the Bill was read a second time it should go to a hybrid committee, which had been already appointed, and before whom all objections would be fully heard. The object of Parliament in passing the Electric Lighting Act was, in the first place, to protect the community against anything in the nature of a monopoly such as had been created in the case of gas and water; and, in the second place, it was to prevent this very important experiment from being stifled by the want of enterprise, of interest, or by prejudice on the part of the local authorities. Local authorities and their objections would be heard. Special objections would be weighed and considered, but if the objections were merely general ones, and if the local authorities wanted the whole matter to be left entirely to them, that they might say whether and when this experiment should be proceeded with, then the Board thought it their duty to cast over the wishes of the local authorities. He would no longer resist the motion that the Electric Lighting (No. 6) Bill should go to the hybrid committee. Mr. R. York said it was unfair to compel the Westminster Board of Works to adopt a system which might turn out to be an inferior one, and to pay the cost of the experiment in the event of its proving a failure. Sir J. M'Garel-Hogg, in the course of some explanatory remarks respecting the action of the Metropolitan Board of Works, said that board intended that the prices should be revised every seven, fourteen, or twenty-one years. After some further discussion the House divided, when the Order for the second reading was carried by 212 to 91.

The hybrid committee appointed to consider the Electric Lighting Provisional Orders Bills met on Thursday at noon. It is composed of Sir A. Bass, Mr. Sclater-Booth, Mr. John Holms, Mr. Whitley, Mr. W. Fowler, Mr. Story Maskelyne, and Mr. Henry Northcote.

The Criterion Theatre, Piccadilly, is to be lighted throughout with about 600 Edison incandescent lamps. The generating plant will comprise two Armington and Sims' horizontal high-speed engines, having 13-inch cylinders and a stroke of 13 inches, running at 275 revolutions per minute, and driving on to countershafting from which will be run four Edison L dynamos, each capable of sustaining 150 16-candle lamps. Each engine will be capable of indicating 84 H.P., at 70 lbs. pressure of steam, and either engine will thus be able to take the whole load in the event of accident or repairs to the other. The wiring will be arranged on eight circuits, each under independent control by means of a specially designed regulator capable of lowering or raising the brilliancy of the lamps from normal candle-power to nil. The contract for the work, which will be carried out by the Edison Electric Light Company, Limited, stipulates for the completion of the installation by the beginning of September.

The Metropolitan Board of Works, which had given notice of its intention to oppose most of the Electric Lighting Provisional Order Bills relating to the metropolis, has withdrawn the whole of its petitions, and will not, therefore, appear in any way before the hybrid committee appointed to consider the merits of these Bills. This action on the part of the Metropolitan Board will have the effect of allowing most of the orders to pass unopposed, while it will also materially shorten the sittings of the committee. The withdrawal of these petitions was brought about in consequence of the strong feeling against any active opposition by the Board which was shown by the representatives of the various parishes proposed to be lighted by electricity.

The Jablochkoff Company appears likely to take a leading position in electric lighting affairs. In its Belvedere Road station there have been recently fitted two of Marshall and Co.'s horizontal 35 H.P. (nominal) engines, and twenty 20-light alternating-current Gramme machines will be in position there, half that number being at present erected. In each circuit of five Jablochkoff candles, 10 Swan incandescent lamps can be worked in combination. From this station 35 candles and 60 incandescence lamps are being run in the Gaiety Restaurant. This installation has, however, been kept in abeyance during the last fortnight owing to a re-arrangement of the circuits. For the forthcoming promenade concerts at the Covent Garden Theatre, 45 candles and 80 incandescence lamps are to be employed, all worked from Belvedere Road. A new feature in these concerts will be the stage scenery, which will represent a Chinese village, for which 10 Jablochkoff lights will be arranged in appropriate lanterns. We shall not be surprised if the Jablochkoff system eventually supersedes all other arc lights for exterior illumination, and for several other purposes also. At its commencement it was the only prominent arc light in London, and it will probably soon be the only one remaining for the purposes we have mentioned.

At the Edinburgh Town Council meeting on Tuesday, letters by the secretary to the Brush Electric Light Company, and the Electric Construction and Maintenance Company, intimating their intention to apply during next session of Parliament for a provisional order to supply electric light in the city, were remitted to the Lord Provost's Commitee with powers. His Lordship said that the expenses obtained by the corporation against the first-named company had not been paid, and there was a doubt as to whether the Board of Trade had power to give expenses. It did seem hard that a company should put the city to an expenditure of this kind again and again.

At a special meeting of the Board of Works for the Westminster district, held yesterday afternoon, Mr. Churchwarden Taylor in the chair, the subject of the electric lighting schemes affecting the district was considered, as also a report of the parliamentary committee that, in pursuance of the authority given by the committee to the Board, they had sealed a petition to the House of Commons against the Electric Lighting Bill No. 8. On the motion of Mr. J. K. Aston, seconded by Mr. Horn, it was resolved that the action taken by the parliamentary committee in regard to electric lighting bills affecting this district be approved; and it was further resolved, on the motion of Mr. J. R. Yorke, M.P., seconded by Mr. S. Helder, that the parliamentary committee be authorised to take such steps in Parliament for supporting the petition against electric lighting schemes affecting this district as they may be advised by the solicitor and parliamentary agents. This resolution was carried by 24 votes in favour to two against. The Board then adjourned.

Lightning Photographs.—Some few weeks ago, during a heavy thunderstorm, four boys, sheltering themselves in a stable at Cairnbank, Duns, were violently thrown down, one of them being rendered unconscious, and the others suffering temporary paralysis of the arms and legs. It was subsequently found that a yew tree, 50 yards distant from the stable had been struck by lightning, and that marks resembling the foliage of the yew tree were imprinted on the bodies of the lads. Shortly after the accident, a gentleman, Mr. Bruce, took a photograph of the marks, but as will be seen from the following letter addressed to a friend in Glasgow, he concludes that the yew tree had nothing to do with the markings.

"Through the thoughtfulness of Mr. Gunn, chemist, I secured a well-defined impression of the 'lightning print' found on the arm of his son, George Gunn, who, along with three other boys, was struck by the electric fluid. So far as I am aware, it would seem that this is the first time this remarkable phenomenon has been photographed, and, perhaps, when the picture is put into the hands of one of our eminent electricians the photographic image may elucidate a point which is at present in the minds of many people rather hazy. In relating the miraculous escape those four boys had from a violent death, a correspondent, while suggesting the popular idea that the delicately-traced figures, so very like fern fronds or branches of trees, are caused by the object which happens to be near the person struck by lightning being printed on the surface of the body, does not identify himself with this theory. He only suggests the current idea that the marks found on the necks and arms of the boys may be representations of a tree not far distant from where they were standing. Now, while it is not to be wondered at that for generations this has been believed, I for one am not prepared to accept the current belief as scientifically correct. The first objection which presents itself to my mind against the generally accepted opinion, that the floral figures impressed upon the skin are photographic representations of surrounding objects, is, that the photographic conditions necessary to form the image and retain it are entirely wanting, namely, a lens and a surface made sensitive to light. But, assuming that a law exists, unknown to us, by which the electric fluid in passing from a thunder-cloud to the earth so rarefies the air, that, as in the case of the mirage, the atmosphere by the laws of reflection and refraction depicts objects as clearly as a photographic lens, and further, that for the time being the surface of the human body is so affected as to become sensitive to light, and thus prepared to receive and retain impressions of surrounding scenery, the 'lightning prints' under these circumstances, would be, I think, different from what we find they really are. The floral figures which were so vividly represented on the bodies of the boys were what may be called positive pictures, namely, a dark picture on a white ground; whereas, had they been formed by the chemical and optical laws that are essential to the formation of the photographic shadow of a tree, they would have been negative pictures—that is, a white picture on a dark ground. There are other objections that might be mentioned, such as the position of the tree referred to by your correspondent in relation to the boys who were within the stable, and also, that while the 'lightning prints' were clearly defined, there was no impression visible from the clothes they wore. I think, however, that sufficient has been said to show that we must search in some other direction for the cause of these mysterious and delicately beautiful forms, and, thanks to the researches and experiments of scientists, the probable explanation is not far to seek. By a simple experiment, a stream of sparks discharged from an electrical machine can be broken up and made to take the exact form of figure found on the arm photographed. Or if a charged Leyden jar be substituted in our experiment, and a pane of glass be interposed between the knob of the vessel and the discharging tongs, a perfect breath figure of the discharge is seen on each side of the glass which bears a most striking resemblance to a tree. Knowing, then, that under certain conditions the sparks from an electric machine may be made to take the form of a brush, a feather, a fern, or a tree, we are, I venture to say, compelled to come to the conclusion that the markings developed on the necks and arms of our young friends were caused by the direct action of the electric fluid, paralysing the nervous system, and causing for a time congestion in the capillary vessels, and therefore redness, wherever the tree-like sparks touched the skin."

Royal Society of Edinburgh.—The sixteenth and last ordinary meeting of the Royal Society for the session was held on Monday evening. Lord Moncreiff, president, at the close of the meeting, gave a brief review of the session. He said there had been four papers on astronomy, two on botany, seven on chemistry, two on geology, four on mathematics, six on meteorology, twenty-three on natural philosophy, nine on natural history, three on philology, two on political economy, and one on physiology—sixty-three papers in all, independently of the obituary notices which had been read. He thought he was not wrong in saying these papers had combined an amount of interest, ability, and novelty which could hardly be excelled, and to a very large extent showing great progress in the subjects treated. He congratulated the society on having reached the point at which they now stood that night. The session, he believed, had been a very successful and a very interesting one, and the topics treated of had been of the greatest possible importance. He said, in opening the session, that it was the 100th session of the Royal Society, and he thought he used a certain amount of artifice or subterfuge when he made that representation. They had now concluded the 99th session and not the 100th. Like other centenarians their claims up to this point had not been well founded, as the real year of the century began in November next. At that time the society was divided into two classes—the physical and the literary. The physical met first on the 4th November, 1783, and the literary on the 17th of the same month. They would, however, celebrate the commencement of their 100th session on the first Monday in December. Referring to the division which originally existed in the society as to physical and literary classes, his lordship said that some one had suggested that they should follow in the footsteps of their predecessors, and have at intervals purely literary papers read in the society. The reason why that for a society of that kind scientific researches were more appropriate was that the literary was fluctuating and stationary, whereas the scientific papers read at their meetings marked the progress of science. Still, he had an ambition in some degree or other to resuscitate that good example of their forefathers, and accordingly next session he would invite any of the fellows of the society who felt inclined to form a literary class. In conclusion, his lordship said that at the commencement of next session he would review the hundred years history of their society.

Canadian Telegraph Extension.—The government will, during the present season, undertake the further extension of Dr. Fortin's telegraph system along the north shore of the Gulf of St. Lawrence. The line is now completed to Bersimis, and it is intended to lay a cable from that point to Godbouh River, near Point de Monts, a distance of 80 miles; thence a land line 75 miles long will run to Moisie River. Next year it is intended to push the land line as far as Esquimaux Point, 15 miles from Mingan Harbour, and 65 miles from Moisie River. Owing to the rugged nature of the country, the numerous deep harbours and fiords with which the coast is indented, the difficulty of constructing a land line east of Mingan is so great, that it is proposed to lay short cables from each important harbour or fishing station until Forteau is reached. This harbour is just inside the Straits of Belle Isle, and only five days' sail from Moville. The completion of the telegraph line to Forteau, it is claimed, will prove a great advantage to shipowners and merchants, as communication can be made with steamships going *viâ* Belle Isle during four or five days of the voyage from Montreal to Europe.—*The Canadian Gazette.*

New York Telegraph Operatives.—A New York telegram, of date July 18th, states that the executive committee of the Western Union Telegraph Company have appointed a committee to consider the complaints of the operatives. In the meantime there will be no strike.

The Duplex Electric Light and Power Storage Company.—In the Chancery Division of the High Court of Justice, on Saturday last, Vice-Chancellor Bacon made an order for the winding-up of this company.

The Vienna International Electrical Exhibition.—On account of the large number of applications from intending exhibitors received by the committee of this exhibition, the north-eastern court of the exhibition buildings, contrary to the original intention of the committee, has been set apart for exhibits. Among the latest applications are those of the Belgian Public Works Ministry, the Danish Navy and War Administration, the English Postal and Telegraph Department, the Ministries of War and Public Education, the Postal and Telegraph Department, and the Police Prefecture of France, and the Italian Telegraph, the Ottoman Telegraph, and the Russian Telegraph Administrations. It has been officially announced that at the exhibition Roumania, Russia, and Turkey will be represented by delegates.

A New Feature in Electric Lighting.—On Saturday last, in the Court of Queen's Bench, presided over by Mr. Justice Manisty, Mr. Bulwer complained of the inconvenience that he had for some hours experienced from horrible smells from the kitchen. Mr. Justice Manisty said that the learned counsel should communicate with the superintendent, and request that something might be done. He had himself suffered from the disagreeable odour. Subsequent investigation showed, it was said, that the smell arose from something connected with the electric lighting of the courts.

Sixpenny Telegrams.—A Treasury minute on sixpenny telegrams was published on Friday of last week. Mr. Childers recommends that authority be given to the Postmaster-General for the necessary preliminary expenses, expected to amount to £500,000, of which £200,000 will be expended in the current financial year. The reduction will be made on October 1st, 1884, but Mr. Childers leaves for further inquiry the question as to the exact manner in which the reduction is to be effected.

House Lighting by Electricity.—It may interest our correspondent, Mr. Barkas, and others to know that Messrs. Shippey Bros.—already alluded to in our Electric Lighting Notes—are representatives of the Woodward Thermopile "Household Electric Generator." Quoting again from the circular of these gentlemen, we are informed that "by the use of the Woodward system of electric lighting the problem of *private household lighting without machinery* is solved;" . . . "the Woodward thermopile electric generators can also be used with advantage to generate the current required to charge the Woodward storage batteries or any other well-known system of electric accumulators;" . . . "by the above system electric light can be obtained anywhere at a reasonable cost." We are almost tempted to ask a few pertinent questions respecting this invention, but we will confine ourselves to remarking that we should feel favoured if Messrs. Shippey Bros. would send us tests of these thermopiles for publication.

Gun-firing by Electricity.—The firing of the 80-ton guns at Dover on Monday was effected by electricity.

Electrical Navigation.—On Tuesday the new launch constructed for the Electrical Power Storage Company by Messrs. Yarrow & Co., and which we mentioned in our Notes of last week, made a trial trip between the Temple Pier and Greenwich. A daily paper professing to have the *largest circulation in the world* describes her as a new *steam* launch, and her most remarkable feature as being the complete absence of either boilers, funnel, or smoke. The following figures are stated to be her proper dimensions, but we are not quite sure of their correctness:—40 ft. long, 6 ft. beam, and having 3 ft. draft of water aft. She was fitted with eighty Sellon-Volckmar secondary batteries, having a weight of 60 lb. each, or in all about two tons, very neatly packed beneath the floor. The screw is 18 in. in diameter, with a 13 in. pitch, and making 680 revolutions per minute, being attached direct to the Siemens' dynamo. The speed attained on the voyage was over 7½ knots; the passage down the river, immediately after the turn of high water, being made in 37 minutes, including the clearing of the screw from a floating basket which had fouled it.

The Invention of the Telephone.—A special dispatch to the St. Louis *Globe-Democrat*, dated Washington, June 28th, states that Mr. McDonough is to be awarded the patent for the telephone receiver in general use. This interference case, in which is involved the right to the telephone receiver, has been pending in the Patent Office for several years. The parties in the case are James W. McDonough, of Chicago, Messrs. Bell, Edison, Gray, Voelker, and several others. The Washington correspondent of the *Globe-Democrat* understands that the decision has been rendered, but it is being secretly printed to avoid publication before it is officially promulgated. It is stated, however, he adds, upon pretty high authority, that Mr. McDonough will be awarded the patent for the telephone receiver. The other inventors will each be awarded a proper share for their respective improvements.

The "Pilsen," "Joel" and General Electric Light Company.—In another column will be found copies of circulars which have been forwarded to us, one of which purports to give the result of an investigation of the accounts of the above company. We are glad to perceive that some one is at length making a move, for starting as it did with good machines and lamps, and not over-burdened with a heavy outlay for patent rights (as is the case with many similar companies), it seems explainable only in one way that so little has been achieved for an expenditure of

£39,100. It may appear that a considerable portion of this amount has been used in manufacturing apparatus still in stock, but the directors can hardly be held justified in carrying out such operations to the extent mentioned, when the trade has been so exceedingly small.

Before any further money is put into the hands of the directors it is imperative that the shareholders should combine to form a committee of investigation and should then decide what course is to be pursued in the future. The company commenced with good prospects, but from causes which it is desirable that the shareholders should ascertain for themselves, the whole business, in one short year (notwithstanding Mr. Gregory's remarks to the contrary), seems to have drifted into a state of complete helplessness. On the other hand it would be advisable that the shareholders of this company, before committing themselves too much to the guidance of Messrs. J. G. Osborne & Co., should make themselves acquainted with the position that firm desires to hold in the matter. Possibly those gentlemen would not view with disfavour the prospect of an official liquidatorship.

Machinery for Electrical Work.—Messrs. Pfeil and Co. have now on view at their show rooms, St. John Street, Clerkenwell, an assortment of lathes and lathe tools especially adapted for electrical engineers.

News Agencies and their Telegrams.—In the Queen's Bench Division of the High Court on Thursday, Mr. Justice Lopes and Mr. Justice Williams, sitting in banco, had before them the case of the Central News *v.* the Eastern Telegraph Company and the Exchange Telegraph Company, an action brought for alleged divulging of telegrams sent from the plaintiffs' agent at Kassassin by the Eastern Company's wires during the war in Egypt. The case did not come before their lordships on its merits, but merely on the question of allowing the plaintiffs' agent, Mr. Burleigh, to be present during the examination of witnesses by commission preparatory to proceeding with the action—these being some telegraph clerks now home temporarily from foreign stations. Mr. Finlay, Q.C., with whom was Mr. Moulton, as counsel for the defendants, remarked, however, that these preliminary proceedings were in the nature of "a full-dress rehearsal," being an inquisition with the object of making out a case against his clients. The defendants objected to the presence of Mr. Burleigh during the examination of these witnesses, on the ground that he was a director and shareholder of the plaintiffs' company and a principal witness for the plaintiffs in the cause. Mr. A. M. Sullivan, who appeared as counsel for the plaintiffs, submitted that the objections of the defendants were not sustainable, and stated that the examiner himself had expressed the opinion that Mr. Burleigh ought to be present during the examination, although he had referred the matter to the court in order to avoid any dispute on the point hereafter. Having heard counsel, the court decided that Mr. Burleigh ought to be present.

The Action of Magnetisation upon the Galvano-Conductive Power of Liquids.—By J. Paktowsky.—A long tube filled with a concentrated solution of ferric chloride was placed within a series of powerful magnetising coils. To weaken polarisation as far as possible both the ends were covered with bladder and plunged into vessels full of solution of zinc sulphate, provided with electrodes of amalgamated zinc. The tube formed one of the sides of a Wheatstone quadrangle, through which was passed a current from six Daniells. On closing and opening the circuit in the magnetising coils no change was perceived in the resistance of the liquid. From preliminary experiments on the sensitiveness of the method, the author concludes that a change of $\frac{1}{183,000}$ of the original resistance could not have escaped detection.—*Wiedemann's Beiblätter.*

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

Buenos Ayres Electric Light Company (Limited).—The second return of this company, made up to the 11th inst., was filed on the 12th inst. The nominal capital is £100,000, divided into 9,986 shares of £10 each and 70 shares of £2 each. 70 shares have been taken up, but no amount has as yet been called thereon. Registered office, 1, East India Avenue.

Domestic Telephone Company (Limited).—The first return of this company, made up to the 25th of May, was filed on the 4th inst., but the only shares recorded as taken up are the seven subscribed for by the signatories to the Memorandum and Articles of Association.

Liverpool Electric Supply Company (Limited).—The first return of this company, made up to the 23rd of May, was filed on May 31st. The nominal capital is £10,000, in £5 shares. 424 shares have been taken up and £2 per share called thereon. The calls paid amount to £708, leaving £140 unpaid. Registered office, 3, Crosshall Street, Liverpool.

Siemens Brothers & Co. (Limited).—The annual return of this company, made up to the 5th ult., was filed on the same date. The nominal capital is £500,000, in £100 shares. The whole of the shares have been taken up, and £75 per share has been called thereon, the calls paid amounting to £375,000. The nominal capital of the company was increased from £400,000 to £500,000 by a special resolution passed at general meetings held on 23rd and 24th of January last. Registered office, 12, Queen Anne's Gate, S.W.

Lyons Electrical Power Storage Company (Limited).—The registered office of this company is at 3, Copthall Buildings, E.C.

CITY NOTES, REPORTS, MEETINGS, &c.

The West Coast of America Telegraph Company (Limited).

THE sixth ordinary general meeting was held at Cannon Street Hotel on Thursday last, Mr. Robinson Kendal, the chairman of the company, presiding.

The Secretary (Mr. F. L. Robinson) read the notice convening the meeting and also the minutes of the previous meeting, and

The report, which we published in our issue of the 14th inst., having been taken as read,

The Chairman said: I have now to move the adoption of the report and accounts. This report is, of course, not so satisfactory as we could wish, but under all the conditions, which are practically known to every one who either reads the newspapers or is interested in trade, it is perhaps almost as good, if not better, than any one expected it to be. For a time we have laboured under serious disadvantages owing to the continuance of the deplorable war and the consequent utter stagnation of trade at Lima, and other important places in Peru; and it is, perhaps, in some degree a matter for congratulation that the company is in the comparatively favourable and progressive condition shown in the report. Up to the 31st December last year, the earnings of the company were £38,908 2s. 10d. against £32,356 15s 11d. for the previous year, showing a net balance of profit, after paying debenture interest and all charges, of £7,667 11s. 1d., a result which, as the report says, though not altogether satisfactory is yet far from unpromising. Since the date up to which the report is made out the company has made further progress, and now I am able to confirm what is said in the report, viz., that the mortgage and all other liabilities and arrears of the company, set down at a sum of £20,465 8s. 5d. in the balance-sheet for 1881, have been discharged and extinguished. With the discharge of all these arrears and liabilities, incurred through a variety of conditions—the cutting of our cables, the continuance of the war, and the paralysation of trade—the company has assumed a much more favourable position, and the outlook, in every sense, may be fairly regarded as far from uncheering. Our receipts have continued to increase under all the adverse circumstances under which our operations have had to be carried on, and nothing is required but an assurance of peace and a revival of trade to still further augment our income and enable us to render to the shareholders an account with which no one will have reason to be dissatisfied. Not that I have either seen or heard, in fact, any expression of dissatisfaction in regard to the present report, but quite the reverse, everything that I have seen or heard being, in regard to our accounts, to our economies, and to our working, not only of a satisfactory but of an agreeable and even complimentary character. In our next report we hope we shall not only show a considerable increase in our income but a diminution in our expenditure, for the large item for interest will have disappeared, except in regard to a small amount now extinguished, and there will be also various other economies which will tend in a greater or lesser degree, if all things go well and as we expect, to increase the net profit of the company's working operations. What the future may bring to us it is not for me to anticipate, but besides the satisfaction of saying that all our past accumulations and indebtedness are now paid off, I have also the satisfaction of saying, that looking inquiringly into matters, our progress and our prospects are the reverse of discouraging. Our steamer has been overhauled and put into a complete state of repair, as verified by the underwriters' survey, and the certificate we have received—and I am pleased to say that through a variety of causes, her value to us has been enhanced, so much so, indeed, that we have increased rather than decreased the amount of insurances for which she is covered. The claim of this company upon the Chilian Government is still in abeyance, but I am not without hopes that in a few weeks, or perhaps days, we may hear something of a more definite and satisfactory character. Since the report was issued to the shareholders we have received from our manager on the coast a letter, in which he says he hopes either to write us by next mail, or to wire to us a fresh offer on behalf of the Government, for a settlement of a part of our claim, the remainder of the claim being submitted for adjudication to the International Commission now sitting and deciding upon claims arising out of the conflict between Chili and Peru. Whatever the result may be, in regard to this claim, I need hardly assure the shareholders that the constant and persistent efforts of the board have been exerted to bring about a settlement, just and honourable alike to this company and to the Chilian Government. At a time when armies were being decimated, and cities were being sacked, and trade and progress arrested and paralysed, it was perhaps too much to expect that the Chilian Government would seriously entertain and settle our claim; but now that matters have assumed a calmer aspect, and peace seems to be in some way assured, as every one hopes, we may reasonably appeal, after so long waiting, to the Chilian Government to do us justice, and in view of the traditions, the honourable traditions of that Government, we hope we shall not appeal uselessly or in vain (hear, hear). I beg to move the adoption of the report and accounts.

Mr. T. F. Campbell seconded.

In answer to a shareholder,

The Chairman said the claim of the company against the Chilian Government was a very large one. That government cut their cables and they lost a large amount of trade, and they had a claim against the government for the loss of trade and also for the actual cutting of the cables.

The motion was unanimously adopted.

The Chairman then explained that in view of the encouraging prospects of the company and not only the possibility but the probability of its being in a better position by-and-by, the directors thought they should be able not only to form an adequate reserve fund but to declare a dividend to the shareholders. Under the articles of association it was impossible for the directors to declare, much less to pay, any dividend without the sanction of a general meeting. Therefore, to obviate delay or the calling of a special general meeting he moved, "That the directors of this company be and are hereby empowered to declare interim dividends out of such profits as may be from time to time available."

Mr. Campbell seconded, and this motion was also adopted.

On the motion of the Chairman, seconded by Mr. Gray, Mr. T. F. Campbell and Mr. W. E. MacAndrew, the retiring directors, were re-elected. Mr. J. Weise, of Messrs. Turquand, Youngs & Co., was re-elected auditor.

A vote of thanks to the Chairman closed the meeting.

The "Pilsen," "Joel," and General Electric Light Company, Limited.

The following circulars, referring to the above company, have recently been issued:—

To the Shareholders of the "Pilsen," "Joel," and General Electric Light Company, Limited.

27, Red Lion Square, London, W.C.,
July, 1883.

Having been favoured with instructions to investigate the accounts of the above company, we have accordingly done so.

As the result of this investigation concerns the interests of the general body of shareholders, it has been deemed essential that they should be communicated with, so as to enable them to take combined action previously to the forthcoming general meeting, and thus prevent any further calls being made and the remaining uncalled capital being dissipated without any reasonable prospect of profit, as has been the case with the £56,000 already paid up.

It is alike impossible and inexpedient to give the detailed results of our investigation in this circular, but upon any *bonâ fide* shareholder calling upon us we shall be happy to furnish him with any information he may require.

You are aware that by the terms of the prospectus upon which the public were invited to subscribe the capital amounted to £200,000, in 40,000 shares of £5 each, of which 12,000 shares were allotted as fully paid up to the vendors, thus leaving 28,000 shares for subscription by the public, from whom applications much exceeding that number were received.

In the allotment, the directors appear to have accommodated their friends by allotting them from 7,000 to 8,000 shares, which accordingly went to a large premium.

The amounts payable on the shares were 10s. on application, £1 10s. on allotment, future calls not to exceed £1 per share, and at intervals of not less than two months.

It appears by the 11th Article of Association that the directors may make calls upon the members as they think fit, and may charge 10 per cent. on the amount of unpaid calls.

The total amount received on account of application and allotment appears by the accounts of the company to be	£55,925
Capital uncalled of £3 per share and arrears	84,075
Being the whole capital offered for public subscription...	£140,000

At the date of our said investigation there remained in cash, of the foregoing sum of £55,925, the following—

Cash on current account at Barclay, Bevan, Tritton & Co.	£824 7 6
Do. deposit do. do.	1000 0 0
Making a total of	£1824 7 6

Thus, the position of the cash account may be broadly stated as follows:—

	£	s.	d.
Amounts at current and deposit account, as before mentioned	£1,824	7	6
Paid to vendors cash consideration for patents	15,000	0	0
Amount spent in carrying on the company to May 31st	39,100	12	6
Being the total paid-up capital ...	£55,925	0	0

We may mention that the total sales up to April 30th, 1883, were about 6 per cent. upon the amount expended as before mentioned of £39,100 12s. 6d.

Thus, in order to carry on the operations of the company, it is obvious that a call of at least £1 per share must immediately be made, the funds in hand being barely sufficient to meet its rapidly accruing liabilities.

We would call your particular attention to the following paragraphs in the prospectus of the company, which stated—

"The plan of operations which the company proposes to adopt and the sources from which it expects to derive profits are:—

"Firstly.—The selling or licensing its rights to subsidiary companies for the British Colonies and different districts of the United Kingdom. Negotiations are now pending, and large results may fairly be anticipated from this source.

"Secondly.—The sales of the various forms of lamps, motors, and the accompanying machinery controlled by the company, and the sale of carbons.

"Thirdly.—Contracts for lighting cities, towns, districts, mills, railway stations, and for furnishing power therein, &c., or for leasing the lamps, motors, and plant for the same.

"Fourthly.—The supplying electricity, when required, for lighting, electro-plating, and other purposes."

It does not appear that the first-mentioned object, which is by far the most important, so far as the profits are concerned, has been carried out in any way. The second is comprised under the head of sales, of which, up to the present time, commercially speaking, there have been none. With regard to the third and fourth, the expenses in connection with their operation are so great that the present capital, if all called up, is quite inadequate for the purpose.

Under these circumstances, it is proposed to form a committee of shareholders to further investigate the financial position of the company, and to consider the best course to adopt.

Those desirous of supporting this course must be good enough to fill up and sign the enclosed form, and return it to us per return of post, as it is most desirable in your interests that immediate action should be taken before any call is made by your directors.

We are,
Your most obedient servants,
J. G. OSBORNE & CO.,
Representing Shareholders holding 2000 *Shares*

The following gentlemen have consented to act as the first members of the Committee of Shareholders:—

James Croyle, Esq, Godstone House, West Hill, Sydenham, representing 500 shares; Geo. Alfred Corderoy, Esq., Hibernia Chambers, London Bridge, representing 200 shares; Peter Tocher, Esq., 207, Piccadilly, representing 125 shares; John Roberts, Esq., Paragon Buildings, Bath, representing 130 shares.

To the Shareholders of the "Pilsen," "Joel," and General Electric Light Company, Limited.

LADIES AND GENTLEMEN,

The attention of the directors has been called to a circular addressed to the shareholders by Messrs. "J. G. Osborne & Co."

The directors premise with remarking that they have no knowledge of Messrs. J. G. Osborne & Co. They are not shareholders. They have not been authorised by the directors to investigate the accounts of the company, although the board have always been ready to furnish all reasonable information to the proprietors. Therefore any information which Messrs. Osborne & Co. may possess must have been obtained second-hand, and can have no claim to authority. In fact, their statement gives an incomplete, imperfect, and misleading view of the position of this company.

The directors do not feel themselves called upon to enter into a detailed analysis of statements which will carry their own answer to the majority of the shareholders, but they may cite as an instance of their value that no notice is taken of the fact that the stock on hire and the supply of electric light on rental yield an annual sum of £1,300.

The directors, however, deem it desirable to warn their shareholders against becoming committed to a policy, the consequences of which the authors of the circular appear not to have foreseen, and which must be most injurious to their own interests.

The directors will be prepared to lay before the shareholders, at the annual general meeting which it will be their duty to convene when the accounts of the year are closed and audited, full details of the position and prospects of the company, and of their management of its affairs, together with their view as to future calls on the company's shares.

These, they believe, will be found as favourable as it is reasonable to expect, considering the extreme depression which has now prevailed for many months in all electric lighting matters, and which has affected, more or less severely, every company engaged in this description of business.

The action of Parliament and the time of the year have, as the shareholders must be aware, combined to prolong the check to the revival of public confidence and to a demand for electric lighting. But the directors have a confident expectation that the now generally recognised excellence of the Pilsen arc lamp and the improvements which they have effected in the manufacture of the Pilsen Dynamo and Gatehouse Incandescent Lamp—the latter being the result of protracted and patient experiments—will secure a full share of profitable business, when, as may certainly be anticipated in the coming autumn and winter, the demand for electric lighting shall have revived, and the company, having overcome the difficulties with which it at first had to contend, will be in a position to take full advantage of the demand for their manufactures.

The board would suggest that any shareholders who may have been induced by Messrs. J. G. Osborne & Co.'s circular to sign any authority to that firm to act for them, to write immediately to cancel such authority.

By order of the board,
E. T. GREGORY, *Secretary*.

July 17th, 1883.
Offices—St. Stephen's Chambers,
Telegraph Street,
London, E.C.

United Telephone Company (Limited).—The report of the directors for the year ending April 30th last, which will be presented to the shareholders at the third annual ordinary general meeting of the company, to be held on the 24th inst., states that the capital account shows that up to the 30th April the sum of £86,582 17s. 7d. was expended upon the works in connection with the London and provincial exchanges, private lines, and the stock of instruments, being £30,616 3s. 11d. more than the outlay shown in the last balance sheet. The revenue accounts show that the receipts of the company from all sources properly attributable to the year was £64,826 1s. 8d., as against £42,624 15s. 3d. in the preceding year, or an increase of £22,201 6s. 5d. The working expenses for the year were £26,434 7s. 10d., as against £19,550 4s. 3d. for the preceding year, and £14,678 3s. for the year ending April 30th, 1881, or an increase of £6,884 3s. 7d. for the year ending April 30th, 1883, over the preceding year. During the past three years the amount of £19,035 1s. 5d. was written off for renewal, maintenance, and depreciation of the London exchange system, including depreciation of lease, office furniture, &c., and instruments in the provinces, of which amount the sum of £11,939 11s. 6d. was in respect of the year ending April 30th. The balance of net revenue account was £28,814 4s. 3d., and the directors recommend the distribution of a dividend of 6 per cent. for the year, leaving a balance of £4,814 4s. 3d. to be carried forward. They have also determined to issue to the shareholders, *pro rata* to their respective holdings, the remaining 20,000 £5 shares at £2 per share premium, payable by instalments, £1 10s. on allotment, £1 10s. on October 1st, 1883, and the remainder by calls to be made (subject to one month's notice) from time to time as required to meet the extension of the company's business. The board hope that the proprietors will find in the above figures evidence that the business is being established and developed in a satisfactory manner, due regard being had to the novelty and difficulty of the work of construction and extenston. In London the number of exchange subscribers on the 30th April, 1881, was 914; on the 30th April, 1882, 1,673; and on the 30th April, 1883, 2,565. Since that date additional subscribers have been connected with the system, which is extending from day to day. The private line business has increased from 186 lines on the 30th April, 1881, to 366 lines in 1882, and 576 in 1883; the rentals for the past year being more than double the value as at 30th April, 1882. During the year the board was compelled to incur considerable expense and assume great responsibility in defending the valuable patents of the company. The board, following the policy already adopted of making over to persons locally interested the management of the telephone business within the limits of particular districts, conditionally upon the formation of district companies affiliated to the parent company, ask the shareholders to confirm the agreement in relation to the South of England Telephone Company (Limited). The general basis of the agreement under which the business is transferred is the repayment to the United Company of all sums expended by them in the district up to the date of the transfer of the business, one-half of the ordinary capital of the District Company, and the further payment of annual royalties upon the telephones used.

The Direct United States Cable Company (Limited.)—The directors' report for the six months ending 30th June last, to be presented at the twelfth ordinary general meeting of the company, to be held on Thursday of next week, states that the revenue for the half-year, after deducting out-payments, amounted to £70,529 19s. 5d. The working and other expenses for the same period, including interest on debentures and income-tax, amounted to £19,315 8s. 9d., leaving a balance of £51,214 10s. 8d. as the net profit of the half-year, making, with £1,286 16s. 0d. brought forward from the previous half-year, a total of £52,501 6s. 8d. Three quarterly interim dividends of 1¼ per cent. each, amounting to £45,532 10s. 0d., have been declared and paid at the usual times during the financial year, and a final dividend of 5s. per share is now proposed, making, with the three interim dividends, 5 per cent. for the year, being a total distribution of £60,710. The appropriation of the balance of £52,501 6s. 8d. on the revenue account is thus shown:—Interim dividend for quarter ending 31st March, 1883, £15,177 10s. 0d.; final dividend now proposed, £15,177 10s. 0d.; carried to reserve fund, thereby increasing it to £315,000, £19,877 17s. 3d.; depreciation of spare cable tank at Halifax, £416 1s. 6d.; carried forward to next account, £1,852 7s. 11d.; total, £52,501 6s. 8d. The depression in the commercial markets and general slackness of business has had an effect upon Atlantic telegraph cable traffic, the earnings from which show a slight decrease during the past six months compared with the corresponding period in 1881, when the tariff was the same. The establishment of the independent office in New York has given general satisfaction.

The India-Rubber, Gutta-Percha, and Telegraph Works Company (Limited).—A half-yearly general meeting of this company will be held on Tuesday, to obtain the sanction of the shareholders to the payment of an interim dividend of 5 per cent., or 10s. per share. The business of the company during the past half-year is said to have been satisfactory. The share register was closed on the 17th to the 25th inst., both days inclusive.

The Telegraph Construction and Maintenance Company (Limited).—The transfer books of this company closed on the 16th to the 24th inst., both days inclusive, preparatory to the payment of an ad interim dividend of 12s. per share to all shareholders on the register on the 16th inst.

The Eastern Telegraph Company (Limited).—This company notifies the opening for traffic of new telegraph stations at Battambang, Cambodia, and at Bangkok, in Siam, the rate to both places from the United Kingdom being fixed temporarily at 7s. 3d. per word.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid	Closing Quotations. July 18.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	7	3¼- 3¾	
		Do. Do.	10	6 - 7	
30,000	5	Australasian Electric Light, Power & Storage Co.	3	½- ¾	
24,900	10	British Insulite Co., Limited, "A" Shares	5	1½- 2½	
30,000	5	Brush Electric Light & Power Co. (Scotland)	2½	⅜- ⅝	
25,000	5	Great Western Electric Light & Power Co.	2½	⅜- ⅝	
24,980	5	Hammond Electric Light & Power Supply Co.	2½	2 - 2½	2½
40,000	5	Indian & Oriental Electrical Storage Works Co.	2	..	
172,500	1	Maxim-Weston Electric Light and Power Co.	1	½- ¾	
..	..	Metropolitan Brush Electric Light & Power Co.	3	..	
40,000	5	Pilsen-Joel & General Electric Light Co.	2	..	
..	..	South African Brush Electric Light & Power Co.	2½	..	
100,000	5	Swan United Electric Light Co., Limited	2½	1⅞- 2⅛	2 1/16
		TELEGRAPHS.			
2,116,400*l.*	Stk.	Anglo-American, Limited	100	48½- 49½	48¾ xd.
2,441,800*l.*	Stk.	Do. Preferred Def'd. receiving no div. until	100	80½- 81½	81.80. xd
2,441,800*l.*	Stk.	Do. Deferred 6 p. c. has been paid to Pref.	100	18½- 19½	18½
130,000	10	Brazilian Submarine, Limited	10	11⅝- 11⅞	11 13/16
16,000	10	Cuba, Limited	10	10½- 11	
6,000	10	Do. 10 per cent. Preference	10	17½- 18½	
13,000	10	Direct Spanish, Limited	9	5¼- 5¾	
6,000	10	Do. 10 per cent. Preference	10	15½- 16	
65,000	20	Direct United States Cable, Limited, 1877	20	12½- 12¾	12 11/16
100,000*l.*	100	Do. 6 per cent. Debenture, repayable 1884	100	99 -102	
380,000	10	Eastern, Limited	10	10¾- 11	10 13/16·⅞ xd.
70,000	10	Do. 6 per cent. Preference	10	12¾- 13¼	xd.
232,000*l.*	100	Do. 6 do. Debentures, repayable Oct. 1883	100	100 -102	
200,000*l.*	100	Do. 5 do. do. Aug. 1887	100	102 -105	
200,000*l.*	100	Do. 5 do do. Aug. 1899	100	104 -107	
199,750	10	Eastern Extension, Australasia & China, Limited	10	11⅝ 11⅞	xd.
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	100	109 -112	
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	102 -106	
140,000	100	Do. do. registered, repayable 1900	100	102 -106	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	102 -105	
254,300*l.*	100	Eastern and South African Limited 5 per cent. Mort. Deb. Registered redeemable 1 Jan 1900	100	101 -104	
345,700*l.*	100	Do. do. do. To Bearer	100	101 -104	
22,050	10	German Union Telegraph and Trust Limited	10	9¾- 10¼	10
163,390	10	Globe Telegraph and Trust, Limited	10	7⅜- 7⅝	½·⅝·½·⅝·9/16
163,209	10	Do. 6 per cent. Preference	10	12⅞- 13⅛	12 13/16
125,000	10	Great Northern	10	12⅝- 12⅞	12 15/16
100,000*l.*	100	Do. 5 per cent. Debentures	100	100 -102	
300,000	100	Do. 5 per cent. Debentures	100	101 -104	
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	30 - 31	
100,000	100	Do. 6 per cent Debentures, 1886	100	103 -108	
17,000	25	Indo-European, Limited	25	32 - 33	
38,148	10	London Platino-Brazilian, Limited	10	3½- 4	
12,000	10	Mediterranean Extension, Limited	10	1½- 2	
8,200	10	Do. 8 per cent. Preference	10	5½- 6½	
9,000	8	Reuter's, Limited	8	9½- 10	
280,000	Stk.	Submarine	100	247 -252	
58,225	1	Do. Scrip	1	2¼- 2½	
4.200	Cert.	Submarine Cables Trust	100	104 -108	106¾
37,350	12	Telegraph Construction and Maintenance	12	33½- 34½	34
150,000	100	Do. 6 per cent, Bonds, 1884	100	98 -101	
186,750	5	Do. 2nd Bonus Trust Cert.	2½	1⅜- 1⅞	
30,000	10	West Coast of America, Limited	10	4¾- 5¼	
150,000	100	Do. 8 per cent. Debentures	100	105 -110	
69,910	20	Western and Brazilian, Limited	15	6 - 6½	
		Do. Preferred	7½	5 - 5½	
		Do. Deferred	7½	1¼- 1½	
200,000*l.*	100	Do. 6 per cent. Debentures "A" 1910	100	105 -109	
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80, red. Feb., 1910	100	98 -102	
1,500	$1,000	Western Union of U. S. 7 p.c.1 Mort.(Building) Bds.	$1,000	122 -124	
,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	103 -106	104.5
88,321	10	West India and Panama, Limited	10	1 - 1¼	
34,563	10	Do. 6 per cent. 1st Preference	10	6½- 7	6¼
4,669	10	Do. 6 do. 2nd do.	10	5 - 5½	
		TELEPHONES.			
154,165	1	Con, Telephone & Maintenance, Ld. Nos. to 154,165	1	⅜- ⅝	
203,000	1	Oriental Telephone Co., Nos. 80,001 to 300,000	½	⅜- ⅝	
100,000	5	United Telephone Co.	5	9 - 9½	

TRAFFIC RECEIPTS.

The Brazilian Submarine Telegraph Company, Limited. The receipts for the week ended July 13th amounted to £2,885.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended July 15th were £2,353, as compared with £2,564 in the corresponding period of 1882.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ended July 13th were £1,853, after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1882.

5552. "Voltaic batteries." L. **HARTMANN.** Dated November 22. 2d. Relates to the construction of voltaic batteries and the preparation and application of their elements in such a manner as to render the electrical production very uniform over long periods of time. For this purpose the inventor employs zinc as the positive element and silver as the negative element, employing as exciting liquid solution of caustic potash or soda. The zinc occupies the middle of each cell and may be surrounded by a porous partition, the silver being at the sides, not in one plate or mass, but in a subdivided form, so as to present in comparatively small space a large amount of surface with numerous interstices for escape of the hydrogen. (*Provisional only.*)

5584. "Electric bell." W. R. **LAKE.** (A communication from abroad by C. F. de Redon, of Paris.) Dated November 23. 6d. In the improved electric bell, the movable armature, the opposing spring, and the rod which carries the hammer are firmly united to constitute one piece having the form of a very flexible spring which surrounds the electro-magnet; this spring carries at one part the armature, and at another part the hammer designed to strike the sounding part of the bell; this spring also serves as the interruptor for making and breaking contact. The whole of the apparatus is carried by the support of the electro-magnet, between the two bobbins of which passes a rod which carries the sounding part of the bell. The latter covers the electro-magnet and the operating mechanism in such a manner that the whole apparatus is very compact and occupies little space. Fig. 1 is a front elevation of the improved electric bell, with the sounding part thereof removed. Fig. 2 is a horizontal centra section of the said bell, and fig. 3 is a vertical central section thereof. A is an electro-magnet mounted upon a support, B, in which is secured a rod, C, carrying the sounding part, D, of the bell which covers the electro-magnet and the operating mechanism, and the box or casing, E, is of circular form and of about the same diameter as the part, D. In front of the poles of the electro-magnet is placed an armature, F, fixed upon a curved spring, G, attached at *a a* and *b* to the support, B. This spring is cut at *c*, to allow the rod, C, to pass through it; a tongue or piece, *d*, is fixed upon the said spring and is designed to make contact with a screw, *e*, which is adjustable in the support, *f*. The interruption of the circuit is effected between the tongue, *d*, and the screw, *e*. The armature, F, and its curved spring, G, are subjected to a series of rapid oscillations which are communicated to the hammer, M, in such a manner that the latter repeatedly strikes the part, D. The distance between the armature and the poles of the electro-magnet is very slight, and the stroke of the hammer is rendered sufficiently great by reason of the speed acquired in the movement of the armature.

FIG. 1.

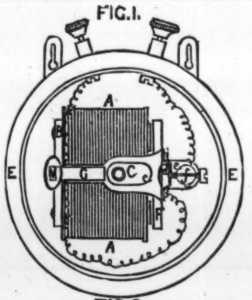


FIG. 3

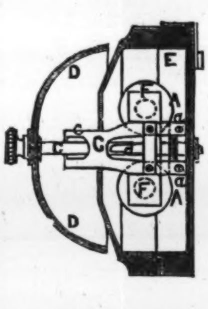
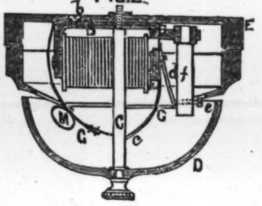
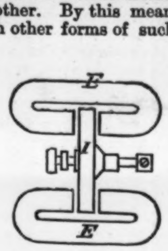


FIG. 2.



5586. "Underground conductors for electric currents for lighting." R. J. **GÜLCHER.** Dated November 23. 2d. Relates to the construction and arrangement of underground conductors for electric currents of low tension used for lighting, and the said invention consists principally in constructing the said conductors entirely of iron, and so that the conductor for the return current constitutes the protecting tube for the conductor leading from the generator to the lamps. According to the said invention the inventor forms the conductor leading from the generator to the lamp of iron rods of convenient length enclosed in iron tubes, the internal diameter of which tubes is greater than the diameter of the said rods; the space between which rods and the interior of the tubes is filled with some suitable insulating material. (*Provisional only.*)

5594. "Dynamo-electric machines." C. D. **ABEL.** (Communicated from abroad by B. Abdank-Abakanowicz and C. Roosevelt, both of Paris.) Dated November 24. 6d. This invention is based on the fact discovered by the said correspondents that the most economical magnetic field is obtained by interrupting a circular electromagnet core at one point for a small distance so that the two poles remain opposite each other. By this means the effect is rendered much greater than with other forms of such cores. The best result is however found to be obtained when the forms of the cores are not exactly circular, but with the polar portions formed straight for some distance, as in the figure.



5631. "Dynamo-electric machines." C. A. **MCEVOY** and J. **MATHIESON.** Dated November 27. 6d. Has for its object improvements in dynamo-electric machines. For this purpose the inventors construct the revolving armature ring or wheel of such machines of a central boss of gun metal, or other non-magnetic material, to be secured to the axis, and which has spokes radiating from it which at their outer end are forked or made U shaped. A ribbon of soft iron is wound into a ring around the outer ends of the spokes, being laid between the two prongs of their forked ends. Numerous turns of the ribbon are thus wound one over the other until the required depth or thickness of iron core or ring is attained. On to the ring so formed are then wound the several coils of insulating conducting wire in the ordinary manner, one by the side of the other all around the ring. The inner end of each coil is also connected to the outer end of the next succeeding coil, and also by a radial conducting bar at one side of the ring to one or other of a number of insulated contact bars which are ranged lengthwise of the axis in the ordinary manner.

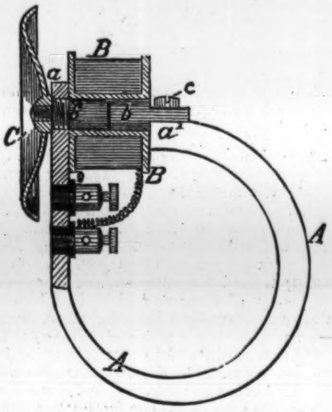
5633. "Telephonic apparatus." H. H. **LAKE.** (Communicated from abroad by C. A. Randall, of New York.) Dated November 27. 8d. Relates generally to that class of telephonic instruments in which the two poles of a magnet act upon each other to produce the vibrations which result in the production of sound, and to induce the currents of electricity required for sound transmission. It also relates to automatic devices by which the receiving telephone and transmitter at a station are placed in and out of circuit. The first part of the invention has for its object to produce an instrument without the ordinary membrane or diaphragm, and which will yet readily respond to and reproduce and transmit all the tones of the human voice. This part of the invention consists in employing an electro-magnet, one pole of which is placed in contact with a wall of the casing or boxing of the instrument, which latter may be of any suitable material, such as wood, india-rubber, glass or the like. The vibrations or changes of the magnetic pole in contact with the casing of the instrument, due to the variations of electrical current, will be communicated to the wall of the casing, and by it be propogated through the air and rendered audible, thus giving the instrument the character of a telephonic receiver.

5644. "Secondary batteries." J. **LEA.** Dated November 28. 2d. In order to obtain the best conducting power in the electrodes of secondary batteries, where lead is the metal employed, the inventor uses a copper plate or sheet (or plates or sheets) of metal of low resistance, and of such a thicknes as to conduct the current produced through the whole of its surface to the part where the connection is made. This plate or sheet (or plates or sheets), constituting the electrode, he coats or encases with lead to any required thickness, whereby the electrode so coated or encased represents an electrode of lead, but with the conducting power of copper.

5645. "Primary voltaic batteries." G. G. **ANDRÉ.** Dated November 28. 8d. For the purpose of the invention the inventor employs carbon in the form of highly burnt coke or wood charcoal and in the condition of small pieces. As an exciting solution he adopts solutions of the salts of potassium, sodium, and ammonium. He employs a shallow tray for the liquid container and places therein another tray, which by holes or otherwise is so connected with the liquid that the latter can come in contact with a diaphragm of felt, flannel, or other absorbent material placed in the upper tray between the metal and carbon electrodes; such diaphragm may be covered with vegetable parchment on which the pieces of carbon are laid; on these latter he places an iron or carbon plate for establishing contact. The level of the liquid is kept over the metal electrode but below the upper surface of the diaphragm.

5677. "Mechanism for regulating the production of electricity." H. **WILDE.** Dated November 29. 2d. Consists in an arrangement of mechanism by which the speed of the electro-generating machine is regulated to supply the varying amount of electricity required to maintain a varying number of lamps in the circuit to their normal degree of incandescence. In this improvement a solenoid of high resistance, or an electro-magnet, is placed in the major circuit in which the lights are produced, and as the strength of the current in the solenoid varies with the diminished or increased number of lamps in the circuit, contacts are made (by means of an iron core within the solenoid acting on a balanced lever) with metal studs connected respectively with two sets of electro-magnets, either of which is excited by the direct major or minor current of the electro-magnetic induction machine. (*Provisional only.*)

5702. "Telephonic receivers." T. **TORREY.** Dated November 30. 6d. Relates to telephonic receivers of the class which operate by a varying magnetic action, produced by the passage of a current of electricity of varying intensity, which passes through a coil of insulated wire forming part of the instrument. Its object is to make a receiving instrument which shall be of simple and solid construction, and therefore not likely to lose its adjustment, and which shall obviate the necessity for the thin disc of iron which has formed a necessary part of nearly all previous instruments of this class. This thin disc is so easily injured by being bent or indented, and thus put out of its proper adjustment relatively to the pole of the magnet which acts upon it, that it has been necessary to protect it from actual contact with external objects by means of a perforated cap. This renders it impossible with such an instrument to bring the vibrating-plate so near the ear as might otherwise be done. These difficulties are avoided according to the present invention by so constructing the instrument that the whole mass of a magnet-pole, sufficiently rigid to maintain its adjustment, shall be thrown into vibration throughout its substance, this vibration being amplified and communicated to the ear by means of an expanded ear-piece of thin metal, vulcanite, or other material possessing sufficient strength and resonance, attached to the vibrating pole in any convenient position, being as near as possible to the point where the varying magnetic action is produced by the coil through which the current passes. The invention may be carried out by the use of either permanent magnets or electro-magnets. In the figure, A is a horse-shoe permanent magnet of a massive rigid character, between the polar extremities, *a* a^1, of which is suspended a coil of insulated wire, B, forming part of the instrument and of the telephonic circuit, whilst to the polar extremity, *a*, is attached an expanded ear-piece, C, of thin metal, vulcanite, or other material possessing the requisite strength and sufficient resonance to convey sonorous vibrations to the ear.



TO CORRESPONDENTS.

Letters, &c., for the "Correspondence" columns should arrive not later than Tuesday morning if they are desired to appear in the following number, such communications to be addressed to the "Editors," ELECTRICAL REVIEW, 22, Paternoster Row, London, E.C.

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CORRESPONDENCE.

Provisional Protection.

It appears that the period of provisional protection in the forthcoming Patent Amendment Act is to be extended to twelve months. This in my opinion will be adding six months of anxiety to the present unsatisfactory arrangement experienced by inventors, especially by those of limited means.

The amount of systematic dodging and organised swindling that the so-called provisional protection admits of is too well known already.

The poor inventor would stand much less risk if the law necessitated the filing of a complete specification, and so settle the matter at once.

On scientific and legal grounds discoveries and inventions should be clearly defined at the date of filing, so as to leave no doubt as to who are the first in the field. What right, I would ask, has an inventor to apply for a patent for an invention before he is able to define the novelty of the particular machine forming the subject-matter of his application? A., a capitalist, might file an application for improvements, &c., in certain apparatus. B., an inventor, might also do the same, a few days after A., for improvements in the same direction, but essentially different from A.'s invention. As B. would probably require assistance in the development of his invention, he might go to A., and the latter might, with the aid of skilful assistance, include the invention of B. in his own final specification, and so claim priority. It is true that the final specification is supposed to be substantially the same as the provisional, but that is a matter that would have to be decided in a court of law, when B., having no capital would, I am afraid, stand a very poor chance.

Provisional protection suits the well-to-do manufacturer and "adapter" rather than the "first and true inventor," whilst it is a powerful weapon in the hands of the unscrupulous.

Inventor.

Electric Light.

When looking through some early numbers of Charles Dickens' *Household Words*, I saw in those for April and May, 1855, an article and a note on the electric light.

As this subject is now so prominently before your readers, I send copies, as you may perhaps think them of sufficient interest to publish as showing what was being done in the matter 28 years since.

F. T. J. Haynes.

Taunton, *July* 14*th*, 1883.

[We thank our Correspondent for the article sent, which will be found in our columns.—EDS. ELEC. REV.]

House-lighting by Electricity.

Towards the end of an excellent and popular article on House-lighting by Electricity, written by Lord Bury, and published in the *Nineteenth Century* for the present month, I note an estimate and statement of the expense of lighting a house by electricity from a primary battery established in or near the house. His lordship says in the course of his remarks, "There is a suitable battery in existence, which I have seen. It has a force of about 1·8 volts; 60 cells would cost about £1 per cell, and to maintain the cells would cost three-eighths of a penny per hour. The cells are bulky, and will not have to be charged every day. Moreover, the batteries do not smell nice. The battery is certainly cheaper in proportion to electrical efficiency than any other with which I am acquainted. It is nearly as strong as two Daniell cells."

I desire to run a parallel with his lordship's statements. There has recently been patented a battery which appears to be much superior to that above described, the outer cells are square, 2 in. in diameter and 6 in. high; the porous cells are 1½ in. diameter and 6½ in. high, 36 of the cells would therefore pack in a case 1 ft. square and 7 in. deep. Each cell yields a current tested by an ammeter of 18 ampères, the internal resistance of each cell is three-twentieths of an ohm and the E.M.F. is 2·4 volts.

We have here a small cell with large current, low internal resistance and extraordinary E.M.F. I estimate that each cell may be profitably supplied at 10s., and the cost of maintaining each cell is said to be less than the eighth of a penny per hour. I presume Lord Bury means three-eighths of a penny per hour *per cell*.

If the above estimates be correct, then 45 cells would do the work of 60 of those referred to by Lord Bury, and the cost would be one-fourth.

These cells have the remarkable property of great permanence; they will supply electric light with undiminished lustre for 10 hours, and only require to be renewed after having been 10 hours in full use with uniform vigour. They would continue to give E.M.F. for hours longer, but not up to the efficient standard.

If the above estimates be correct, and I have reason to believe they are, we have now the means of lighting remote country houses by electric energy at a very moderate cost and without any of the danger and nuisance arising from steam-engines, dynamos, high tension currents, &c.

I anticipate that in a few weeks these batteries will be fairly before the public, but in the meantime I refrain from naming the inventor.

T. P. Barkas.

Newcastle-on-Tyne, *July* 16*th*, 1883.

The Electrical Transmission of Power.

Will you kindly state in your next number for what *g* stands in formula 1, page 22, in your last number (July 14)?

Wm. Jones.

72, Thomson Street, Manchester, *July* 16*th*, 1883.

[In the formula, *g* is the "accelleratrix," which in English is 32·1 and in French measure 9·81.—EDS. ELEC. REV.]

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